

EPA Contract No.: 68-S7-3002
Work Assignment No.:038-RDRD-03H6
Black & Veatch Project No. 47118.130

Intermediate (60%) Basis of Design/Design Criteria Report
Revision: 0
December 4, 2003

APPENDIX H

Intermediate Design Specifications

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Submitted as Separate Document

Intermediate Specifications

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SECTION 01015 - PROJECT REQUIREMENTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the project requirements for items of work under this Subcontract.

1-2. GENERAL DESCRIPTION OF WORK. The work to be performed under the Subcontract Documents, hereinafter referred to as the Work, consists of the excavation and offsite disposal of contaminated soils at the Standard Chlorine of Delaware Site (SCD).

The SCD Site is located on Governor Lea Road, in an industrialized area located approximately three miles northwest of Delaware City in New Castle County, Delaware. Residential and commercial properties are located within one mile of the facility (to the west). The SCD Site is bordered to the east by Occidental Chemical Company (formerly Diamond Shamrock Company) property, to the west by Air Products, Inc. and to the south by Governor Lea Road. Governor Lea Road separates the SCD Site from property owned by Motiva Enterprises, LLC (formerly Star Enterprises) and Connectiv (formerly Delmarva Power and Light).

The Work involves soil erosion and sediment control; excavation, transportation, and disposal of contaminated materials; earthwork; construction of waste water treatment system; installation of low volume product recovery wells; installation of extraction wells; installation of groundwater containment barrier; site restoration; and other appurtenant site work.

The Work to be performed at each property under these Contract Documents is generally described as follows:

- Construction of eight extraction wells, furnishing and installation of well pumps and controls, and completion of said wells for operation.
- Construction of groundwater main from the above extraction wells to the new groundwater treatment plant to be constructed at the property.
- Construction of new treatment plant building, associated utility services, and sitework.
- Furnishing and installation of new treatment plant process system, including all equipment, process piping, electrical power and controls, and distribution control system.
- Construction of a new effluent main from the treatment plant to a discharge point along the shoreline of Red Lion Creek.

- Construction of energy dissipation feature(s) necessary to minimize the impact of the treatment plant discharge on the wetlands surrounding Red Lion Creek.
- Preparation of a Startup Plan and Operation and Maintenance Manual for the groundwater collection and treatment systems.
- Startup and testing.
- Long-term (up to 30 months) operation and maintenance of the new treatment plant after successful startup.

1-3. HEALTH AND SAFETY. Subcontractor shall perform the Work in accordance with Contractor's Site Health and Safety Program, provided as an attachment to the Subcontract; the applicable Occupational Safety and Health Administration (OSHA) regulations; and all Federal, State, and Local regulations related to hazardous waste construction.

1-4. SITE ACCESS. Contractor will obtain access agreements for each property from EPA and provide to Subcontractor prior to the start of Work.

1-5. NOTICES TO OWNERS AND AUTHORITIES. Subcontractor shall notify property owners, utility companies, and authorities when prosecution of the Work may affect them.

When it is necessary to temporarily deny access to property, interrupt any utility service connection, or cut a tree, Subcontractor shall give notices at least 14 calendar days in advance to enable the affected property owners to provide for their needs. Notices will conform to any applicable local ordinance and, whether delivered orally or in writing, will include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

Subcontractor shall contact utility companies and other concerned agencies in accordance with Specification Section 02600 - Existing Utilities, prior to any work near underground utilities or pole lines.

1-6. LINES AND GRADES. Subcontractor shall perform all Work to the lines, grades, and elevations indicated on the Subcontract Drawings. All survey, layout, and measurement work shall be performed by a surveyor arranged by Subcontractor. Subcontractor's surveyor shall be a licensed surveyor in the State of Delaware.

Subcontractor shall keep Contractor informed at least 48 hours in advance of the times and places at which Subcontractor wishes to do Work, so that any checking deemed necessary by Contractor may be done with minimum inconvenience to Contractor and minimum delay to Subcontractor.

Subcontractor shall remove and reconstruct Work which is improperly located, as determined by Contractor.

1-7. SITE ADMINISTRATION. Subcontractor shall be responsible for all areas of the property used by Subcontractor and all Second-Tier Subcontractors in the performance of the Work. Subcontractor will exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to property owners or others. Subcontractor has the right to exclude from the property all persons who have no purpose related to the Work or its inspection, and may require all persons on the site (except property owner's employees) to observe the same regulations as Subcontractor requires of their employees.

1-8. RESPONSIBILITY FOR MATERIALS AND EQUIPMENT. Subcontractor shall be fully responsible for all materials and equipment which Subcontractor has furnished.

1-9. PROTECTION OF PUBLIC AND PRIVATE PROPERTY. Subcontractor shall protect, shore, brace, support, and maintain all existing structures, property, trees, wells, underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by the Work. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all shrubs, grass, trees, parkways, and medians, shall be restored to their original condition by Subcontractor whether within or outside the easement, unless otherwise noted on the Subcontract Drawings. Subcontractor shall make all replacements with new materials.

All fire hydrants and water control valves shall be kept free from obstruction and available for use at all times.

1-10. DAMAGE TO EXISTING PROPERTY. Subcontractor will be held responsible for any damage to existing structures, Work, materials, or equipment because of Subcontractor's operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to Contractor.

Subcontractor shall be responsible for all damage to streets, roads, curbs, buildings, sidewalks, highways, shoulders, ditches, embankments, culverts, wells, bridges, or other public or private property, which may be caused by transporting equipment, materials, or workers to or from the Work. Subcontractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

PART 2 - PRODUCTS

2-1. SUBSTITUTES AND "OR-EQUAL" ITEMS. Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or

vendor, the specified item mentioned shall be understood as establishing the type, function, and quality desired. Requests for review of equivalency will not be accepted from anyone except Subcontractor, and such requests will not be considered until after the Subcontract has been awarded. Other manufacturers' products will be accepted provided sufficient information is submitted to allow Contractor to determine that the products proposed are equivalent to those named. Such items shall be submitted to Contractor in accordance with Specification Section 01300 - Submittals.

Whenever the names of proprietary products or the names of particular manufacturers or vendors are used, it shall be understood that the words "or equal" following the enumeration, if not specifically stated, are implied.

2-2. PREPARATION FOR SHIPMENT. All materials that require shipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage.

Each item, package, or bundle of material shall be tagged or marked as required by the Subcontract Documents. Complete packing lists and bills of material shall be included with each shipment and submitted to Contractor in accordance with Specification Section 01300 - Submittals.

PART 3 - EXECUTION

3-1. SALVAGE OF MATERIALS AND EQUIPMENT. Subcontractor shall carefully remove, in a manner to prevent damage, all materials and equipment indicated within the Subcontract Documents to be salvaged or reused, or as requested by Contractor. Subcontractor shall store and protect items specified to be salvaged or reused in the Work. Any items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by Subcontractor in kind or with new items.

Subcontractor, at no additional cost to Contractor, may elect to furnish and install new items in lieu of those specified or indicated to be salvaged or reused, in which case such removed items will become Subcontractor's property. Existing materials and equipment removed, and not reused as a part of the Work, shall become Subcontractor's property.

Existing materials and equipment removed by Subcontractor shall not be reused in the Work except where so specified or indicated.

3-2. CONNECTIONS TO EXISTING FACILITIES. Unless otherwise specified or indicated, Subcontractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities. In each case, Subcontractor shall receive permission and coordinate work with any affected property owner and owning utility company prior to undertaking connections. Subcontractor shall protect facilities against deleterious substances and damage.

Connections to existing facilities which are in service shall be thoroughly planned in advance by Subcontractor, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously, without stoppages, if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility company.

3-3. UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, saturated ground, or other unsuitable construction conditions as determined by Contractor, Subcontractor shall confine his operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would adversely affect the quality or efficiency thereof, unless special means or precautions are taken by Subcontractor to perform the Work in a proper and satisfactory manner.

3-4. CUTTING AND PATCHING. Subcontractor shall perform all cutting and patching required for the Work and as may be necessary in connection with uncovering Work for inspection or for the correction of defective Work. Subcontractor shall perform all cutting and patching required for and in connection with the Work, including but not limited to the following:

- Removal of improperly timed Work.
- Removal of samples of installed materials for testing.
- Alteration of existing facilities.
- Installation of new Work in existing facilities.

Subcontractor shall provide all shoring, bracing, supports, and protective devices necessary to safeguard all Work and existing facilities during cutting and patching operations. Subcontractor shall not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without Contractor's concurrence.

Subcontractor shall cut and remove materials to the extent indicated on the Subcontract Drawings or as required to complete the Work as directed by Contractor. Materials shall be removed in a careful manner, with no damage to adjacent facilities or materials. Materials which are not to be salvaged, as indicated within the Subcontract Drawings, shall be removed from each property by Subcontractor.

Subcontractor shall restore all Work and existing facilities affected by cutting operations with new materials, or with salvaged materials acceptable to Contractor, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished.

3-5. CLEANING UP. Subcontractor shall keep the premises free at all times from accumulations of waste materials and rubbish. Subcontractor shall provide adequate trash receptacles about each property and shall promptly empty the containers when filled, or as requested by Contractor.

Construction materials such as concrete forms and scaffolding shall be neatly stacked by Subcontractor when not in use. Subcontractor shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

Wastes shall not be buried or burned on any property or disposed of into storm drains, sanitary sewers, streams, or waterways. Subcontractor shall handle and dispose of all waste materials from each property in accordance with Specification Section 01606 - Materials Handling and Disposal.

3-6. REFERENCE STANDARDS. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, laws, or regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated. However, no provision of any referenced standard, specification, manual, or code (whether or not specifically incorporated by reference in the Subcontract Documents) shall be effective to change the duties and responsibilities of Subcontractor, Contractor, or any of their Consultants, agents, or employees from those set forth in the Subcontract Documents, nor shall it be effective to assign to Contractor, or any of Contractor's Consultants, agents, or employees, any duty or authority to supervise or direct the furnishing or performance of the Work.

3-7. MEETINGS.

3-7.01 Preconstruction Meeting. Prior to commencement of the Work, a preconstruction meeting will be held at a mutually agreed time and place. The purpose of the meeting will be to designate responsible personnel and establish a working relationship. The meeting shall be attended by:

- Subcontractor and Subcontractor's Superintendent.
- Principal Second-Tier Subcontractors.
- Representatives of principal suppliers and manufacturers as appropriate.
- Contractor and Contractor's Resident Project Representative.
- Government representatives as appropriate.
- Others as requested by Subcontractor, property owners, or Contractor.

Unless previously submitted to Contractor, Subcontractor shall bring to the meeting a preliminary schedule for progress, procurement, values for progress payment purposes, and shop drawings and other preconstruction submittals. Matters requiring coordination will be discussed and procedures for handling such matters established. The meeting agenda will include:

- Subcontractor's preliminary schedule.
- Transmittal, review, and distribution of Subcontractor's submittals.
- Processing Applications for Payment.
- Maintaining record documents.
- Critical work sequencing.
- Field decisions and change orders.
- Working hours, use of premises, storage areas, security, housekeeping, and property owner's needs.
- Major equipment deliveries and priorities.
- Subcontractor's assignments for safety and first aid.
- Site Health and Safety Program.

Contractor will preside at the meeting and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

3-7.02 Progress Meetings. Subcontractor shall schedule and hold regular progress meetings at a mutually agreed time and place at least weekly and at other times as requested by Contractor or required by progress of the Work. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may have developed. Subcontractor, Contractor, and all Second-Tier Subcontractors active on the project shall be represented at each meeting.

Subcontractor may at their discretion request attendance by representatives of their suppliers, manufacturers, and other Second-Tier Subcontractors. Contractor shall preside at the meetings and provide for keeping and distribution of the meeting minutes.

End of Section

SECTION 01025 - MEASUREMENT AND PAYMENT

1.0 SCOPE

This section covers methods of measurement and payment for items of Work under this Subcontract.

2.0 GENERAL REQUIREMENTS

The total Subcontract price shall cover all Work required by the Subcontract Documents. All costs in connection with the proper and successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; and performing all necessary labor and supervision to fully complete the Work shall be included in the unit and lump sum prices bid by Subcontractor.

All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Subcontractor and all costs in connection therewith shall be included in the prices bid.

3.0 ESTIMATED QUANTITIES

All estimated quantities stipulated in the Bid Form or other Subcontract Documents are approximate and are to be used only as a basis for estimating the probable cost of the Work and for the purpose of comparing the bids submitted for the Work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished as measured by Contractor.

Subcontractor agrees that they shall make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts thereof.

4.0 MOBILIZATION/DEMOBILIZATION

Measurement and payment for Mobilization/Demobilization shall be based on the lump sum price for this item in the Bid Form. Mobilization/Demobilization shall include all labor, materials, and other pertinent costs required for the mobilization and demobilization of all equipment, tools, and personnel to and from the Site and between properties; and the acquisition of all permits necessary to complete the Work including applications for electric, natural gas and water service; preparation and submission of the Construction Quality Control Plan; and conducting the Preconstruction meeting.

5.0 SITE WORK

Measurement and Payment for Site Work shall be based on the lump sum price for this item in the Bid Form. Site Work shall include all labor, materials, and other pertinent costs necessary for

furnishing a construction trailer and appurtenant equipment, construction and maintenance of erosion and sediment controls; installation of security fencing; location of existing utilities; removal of existing chain link fencing and gate; clearing and grubbing; tree removal; construction of temporary and permanent haul and access roads; monitoring of structures during excavation and backfill activities; perform test pits; and all other appurtenant work indicated in the Subcontract Documents.

This item does not include excavation of contaminated soils, backfill, soil characterization sampling, and the associated waste handling and disposal which will be paid under other items.

6.0 GROUNDWATER EXTRACTION WELL INSTALLATION

Measurement and Payment for Groundwater Extraction Well Installation shall be based on the lump sum price for this item in the Bid Form. Groundwater Extraction Well Installation shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; properly install and develop the well; excavate and construct the well vault; properly install the submersible groundwater extraction pump and all associated piping, electrical wiring, and controls; disposal of drill cuttings and development water; associated piping and trenching between the vault and treatment building; and all other appurtenant work indicated in the Subcontract Documents.

The final well boring and casing quantities and the final conveyance piping quantities will be determined by the Contractor based upon the actual quantities of Services performed and materials installed during the well installation. The unit adjustment prices stated in the Bid Form shall apply for items of Services conducted during the well installation.

The Contractor will have representatives in the field during the well installation. They will observe the Services performed to determine, in general, if the Services are proceeding in accordance with the intent of the Agreement. They may request adjustments in the Services as required. The Contractor's field representatives will approve well locations; maintain a log of each well; authorize changes in the Services to be performed; and oversee the performance of the Services. Adjustments to the Services, which may be required as directed by the Contractor, shall be performed or deleted by the Subcontractor in accordance with this Agreement and unit adjustment prices stated in the Bid Form. Changes that are required and that are not included in the scope of services or in the Bid Form shall be verbally approved by the Contractor, and a letter stating the change and the unit adjustment price shall be submitted by the Subcontractor to the Contractor for approval.

6.01 Groundwater Extraction Well Casing Unit Adjustment Price. The unit adjustment price for permanent outer casing shall include the cost of furnishing and installing the casing in place. Payment for permanent casing will be made on the basis of the actual footage of casing installed, measured from the ground surface to the depth authorized by the Contractor.

6.02 Groundwater Extraction Well Riser Piping Unit Adjustment Price. The unit adjustment prices for riser piping shall include the cost of furnishing and installing the riser piping in place.

Payment for riser piping will be made on the basis of the actual footage of riser piping installed, measured from the ground surface to the depth authorized by the Contractor.

- 6.03 Groundwater Extraction Well Screen Adjustment Price. The unit adjustment price for well screen shall include the cost of furnishing and installing the screen in place. Payment for well screen will be made on the basis of the actual footage of well screen installed as authorized by the Contractor.
- 6.04 Groundwater Extraction Well Borings Unit Adjustment Price. The unit adjustment price for drilling borings shall include the costs of all labor, materials, and equipment required including all costs of labor, materials and equipment required for the boring in bedrock to include coring and reaming to the diameter required. The unit adjustment price for borings shall include the costs of making borings and supplying water and all other appurtenant drilling costs. Payment for borings will be made on the basis of actual footage of boring advanced, measured from the ground to the depth authorized by the Contractor.
- 6.05 Groundwater Extraction Well Sealing Unit Adjustment Price. The unit adjustment price for grout sealing borings in which wells are not installed shall include the cost of all labor, materials, and equipment as required by the Contractor. Payment for grout sealing will be made on the basis of the actual footage of the boring grouted.

7.0 TREATMENT BUILDING

Measurement and Payment for the Treatment Building shall be based on the lump sum price for this item in the Bid Form. Treatment Building shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals including New Castle County building permits; perform any required geotechnical testing for foundation design; prepare design documents as required; and properly construct the foundation and building; install all associated electrical wiring, heating, and controls; and all other appurtenant work indicated in the Subcontract Documents.

This item does not include the associated piping and equipment for the treatment system which will be paid under other items.

8.0 TREATMENT SYSTEM

Measurement and Payment for Treatment System shall be based on the lump sum price for this item in the Bid Form. Treatment System shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; prepare system design documents as required; properly construct the system; install all associated equipment, piping, pumps, tanks, and controls; excavate, trench and install influent piping between the well vaults and the system and effluent piping from the system to the Contractor authorized discharge point; construct energy dissipation features to reduce the impact of the system discharge on the Red Lion Creek wetlands; and all other appurtenant work indicated in the Subcontract Documents.

This item does not include the associated treatment building which will be paid under other items.

8.01 Groundwater Extraction Conveyance Piping Unit Adjustment Price. The unit adjustment price for groundwater extraction conveyance piping shall include the cost of furnishing and installing the piping in place. Payment for extraction conveyance piping will be made on the basis of the actual footage of piping installed to connect all extraction wells to the treatment system as authorized by the Contractor.

8.02 Treated Water Conveyance Piping Unit Adjustment Price. The unit adjustment price for treated water conveyance piping shall include the cost of furnishing and installing the piping in place. Payment for treated water conveyance piping will be made on the basis of the actual footage of piping, measured from the treatment system building to the treated water discharge point authorized by the Contractor.

9.0 PLANT CONTROLS AND MONITORING SYSTEM

Measurement and Payment for Plant Controls and monitoring system shall be based on the lump sum price for this item in the Bid Form. Controls and monitoring system shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; properly configure and program the system; install all associated hardware and software; and all other appurtenant work indicated in the Subcontract Documents.

10.0 SYSTEM START UP AND PROVE OUT

Measurement and Payment for System start up and prove out shall be based on the lump sum price for this item in the Bid Form.

11.0 EXCAVATION

Measurement and Payment for Excavation shall be based on the unit price per cubic yard for this item in the Bid Form. Excavation shall include all labor, materials, and other pertinent costs necessary to prepare and submit the required submittals; install sheeting and shoring; dewatering; excavate materials from areas indicated on the Subcontract Drawings or as directed by Contractor; and all other appurtenant work indicated in the Subcontract Documents.

The number of cubic yards of Excavation shall be based on the in-place compacted volume as measured by Contractor's surveyor. The in-place compacted volume shall be measured by the average end area method from cross sections taken before and after the excavation activities.

This item does not include associated waste characterization handling and disposal which will be paid under other items.

12.0 SOIL CHARACTERIZATION SAMPLING AND ANALYSIS

Measurement and Payment for Soil Characterization Sampling and Analysis shall be based on the unit price per sample for this item in the Bid Form. Soil Characterization Sampling and Analysis shall include all labor, materials, and other pertinent costs necessary to prepare and submit the required submittals; collect, containerize, label, delivery to the laboratory, and analysis of quality control (QC) confirmatory soil samples; and all other appurtenant work indicated in the Subcontract Documents.

The measurement of QC soil characterization samples shall include only those samples indicated within Specification Section 01605 - Sampling for Chemical Testing and additional samples as directed by Contractor. The measurement of QC soil characterization samples shall not include any samples taken by Subcontractor without Contractor's authorization.

13.0 BACKFILL

Measurement and Payment for Backfill shall be based on the unit price per cubic yard for this item in the Bid Form. Backfill shall include all labor, materials, and other pertinent costs necessary to prepare and submit the required submittals; backfill and compact excavations with clean backfill; perform required QC sampling and testing of backfill and fill materials; final grading; and all other appurtenant work indicated in the Subcontract Documents.

The number of cubic yards of Backfill shall be based on the in-place compacted volume as measured by Contractor's surveyor. The in-place compacted volume shall be measured by the average end area method from cross sections taken before and after backfill.

The measurement of in-place compacted volume will not include the volume of subgrade material or other material that is scarified and reused in-place.

14.0 NON-CONTAMINATED WASTE HANDLING AND DISPOSAL

Measurement and Payment for Non-Contaminated Waste Handling and Disposal shall be based on the unit price per ton for this item in the Bid Form. Non-Contaminated Waste Handling and Disposal shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; properly handle, separate, stockpile, containerize, store onsite, load, transport, dispose at an approved non-hazardous disposal facility, or otherwise handle all non-contaminated waste materials; perform QC sampling and testing to define appropriate disposal methods; respond to and appropriately handle waste material spills; and all other appurtenant work indicated in the Subcontract Documents.

The number of tons of non-contaminated waste material shall be the actual weight of materials loaded and transported offsite for disposal. Weigh tickets from the disposal facility shall be used to establish the weight of materials.

15.0 CONTAMINATED WASTE HANDLING, PRETREATMENT, AND DISPOSAL

Measurement and Payment for Contaminated Waste Handling, Pretreatment, and Disposal shall be based on the unit price per ton for this item in the Bid Form. Contaminated Waste Handling, Pretreatment, and Disposal shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; properly handle, separate, stockpile, containerize, store onsite, load, transport, or otherwise handle contaminated waste materials designated for pretreatment and disposal; perform QC sampling and testing to define the appropriate pretreatment and disposal methods; perform required pretreatment and disposal at an approved RCRA treatment and disposal facility; respond to and appropriately handle hazardous waste material spills; and all other appurtenant work indicated in the Subcontract Documents.

The number of tons of contaminated waste material for this pay item shall be the actual weight of materials loaded and transported offsite for pretreatment and disposal. Weigh tickets from the treatment and disposal facility shall be used to establish the weight of materials.

16.0 SITE RESTORATION

Measurement and Payment for Site Restoration shall be based on the lump sum price for this item in the Bid Form. Site Restoration shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; remove erosion and sediment controls and security fencing; construct the new chain link fence and gate; turf establishment; tree planting; surface treatment; site clearing and cleanup; and all other appurtenant work indicated in the Subcontract Documents.

This item does not include the associated earthwork, or waste handling and disposal which will be paid under other items.

17.0 DECONTAMINATION

Measurement and Payment for Decontamination shall be based on the lump sum price for this item in the Bid Form. Decontamination shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; construct and operate approved decontamination stations as necessary; perform the necessary decontamination of equipment and personnel throughout performance of the Work; collect decontamination liquids and materials; and all other appurtenant work indicated in the Subcontract Documents.

This item does not include the associated site preparation, earthwork, or waste handling and disposal which will be paid under other items.

18.0 SYSTEM OPERATION AND MAINTENANCE

Measurement and Payment for System Operation and Maintenance shall be based on the unit price for this item in the Bid Form. System Operation and Maintenance shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; perform required

system influent outfall and process sampling and analysis necessary to ensure proper operation of the treatment system and compliance with all operating permits; inspection and repair (as needed and authorized by Contractor) of all system components; and all other appurtenant work indicated in the Subcontract Documents.

19.0 REPLACEMENT OF CARBON

Measurement and Payment for Replacement of Carbon shall be based on the unit price for this item in the Bid Form. Replacement of Carbon shall include all labor, materials, and other pertinent costs required to prepare and submit the required submittals; schedule carbon replacement; remove transport and regenerate spent carbon from the treatment system; purchase and installation of new regenerated carbon of a type that is appropriate to the application; and all other appurtenant work indicated in the Subcontract Documents.

End of Section

Section 01070 - ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	American Refrigeration Institute
ASAH	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers

ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
Fed Spec	Federal Specification
FCI	Fluid Controls Institute
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
FTI	Facing Tile Institute
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association

HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrument Society of America
MHI	Materials Handling Institute
MIL	Military Specification
MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBHA	National Builders Hardware Association
NBS	National Bureau of Standards
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	National Sanitation Foundation
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association

OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
RTI	Resilient Tile Institute (formerly AVATI)
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SDI	Steel Door Institute
SFPA	Southern Forest Products Association
SI	Système International des Unités (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation

End of Section

Section 01300 - SUBMITTALS

1.0 PROGRESS SCHEDULE

After the preconstruction conference and before Work is started, Subcontractor shall submit to Contractor for review a schedule of the proposed construction operations. The progress schedule shall indicate the sequence of the Work, the time of starting and completion of each part, the installation date for each major item of equipment, and the time for making connections to existing piping, structures, or facilities.

At least every 10 days the schedule shall be revised as necessary to reflect changes in the progress of the Work.

1.01 Shop Drawings Schedule. At the time the initial schedule is submitted, a schedule shall be submitted of the items of materials and equipment for which Shop Drawings are required by the Specifications. For each required Shop Drawing, the date shall be given for intended submission of the drawing to Contractor for review and the date required for its return to avoid delay in any activity beyond the scheduled start date. Sufficient time shall be allowed for initial review, correction and resubmission, and final review of all Shop Drawings.

1.02 Pework Submittals. Within the number of calendar days indicated of receiving the Notice to Proceed and prior to beginning Work onsite, the following documents shall be submitted:

- Draft Final Work Plan (10 days)
- Site Health and Safety Plan (10 days)
- Construction Quality Control Plan (15 days)
- Operator's Interface Unit (OIU) Submittal - Conceptual (23 days) and Detailed (30 days)

The Subcontractor shall revise the Work Plan, submitted with the Bid Documents, based on the Contractor's comments. The Work Plan shall address the equipment, materials, labor, and methods used to conduct the Work.

The Subcontractor's Site Health and Safety Plan (SHSP) shall comply with the Contractor's Construction Health and Safety Program (CHASP) (Appendix J), and shall address all tasks conducted by the Subcontractor. Additional information for the SHSP is previewed in the General Terms and Conditions, Article 27.

The Subcontractor shall prepare and submit for approval a Construction Quality Control Plan (CQCP) which describes in detail all QC testing that will be performed to ensure and document compliance with the contract documents. The plan will also address sampling for chemical testing performed by Subcontractor. Submittal of the CQCP shall be in accordance with the Specification Sections 01605 - Sampling For Chemical Testing and 01400 - Quality Control.

The Subcontractor shall prepare and submit for approval a Conceptual and Detailed Operator's Interface Unit Submittal as described in Section 16901 - Plant Control System. These submittals involve details of the plant control system including software design, vendor selection, hardware requirements, etc.

2.0 DAILY SUMMARY REPORTS

Subcontractor shall submit daily reports that will document work activities and serve as a communications tool. Items included in the report will include, but not be limited necessarily to the following:

- Summary of construction activities by area;
- Personnel, equipment, and subcontractors that were on-site that day;
- Weather;
- Anticipated schedule of upcoming QC testing;
- Problems or potential problems encountered;
- Requests for information;
- Directions received from Contractor;
- Schedule of planned activities requiring direct observation by Contractor; and
- Other.

Daily Reports shall be furnished to Contractor's Resident Engineer by 10:00 a.m. the following work day morning.

3.0 PROGRESS REPORTS

A progress report shall be furnished to Contractor with each Application for Payment. If the Work falls behind schedule, Subcontractor shall submit additional progress reports at such intervals as Contractor may request.

Each progress report shall include sufficient narrative to describe current and anticipated delaying factors, their effect on the progress schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Contractor, must be substantiated with satisfactory evidence.

Each progress report shall also include three prints of the accepted graphic schedule marked to indicate actual progress.

4.0 SCHEDULE OF VALUES

After review of the preliminary schedule at the preconstruction conference, and before submission of the first Application for Payment, Subcontractor shall prepare and submit to Contractor a schedule of values covering each lump sum item. The schedule of values, showing the value of each kind of work, shall be acceptable to Contractor before any Application for Payment is prepared.

The sum of the items listed in the schedule of values shall equal the Contract Price. Such items as Bond premium, temporary construction facilities, and plant may be listed separately in the schedule of values, provided the amounts can be substantiated. Overhead and profit shall not be listed as separate items.

An unbalanced schedule of values providing for overpayment of Subcontractor on items of Work which would be performed first will not be accepted. The schedule of values shall be revised and resubmitted until acceptable to Contractor. Final acceptance by Contractor shall indicate only consent to the schedule of values as a basis for preparation of applications for progress payments, and shall not constitute an agreement as to the value of each indicated item.

5.0 SCHEDULE OF PAYMENTS

Not required.

6.0 SURVEY DATA

All field books, notes, and other data developed by Subcontractor in performing surveys required as part of the Work shall be available to Contractor for examination throughout the construction period. All such data shall be submitted to Contractor with the other documentation required for final acceptance of the Work.

7.0 SHOP DRAWINGS AND ENGINEERING DATA.

7.01 General. Shop Drawings and engineering data (submittals) covering all equipment, fabrications, and building materials which will become a permanent part of the Work under this Subcontract shall be submitted to Contractor for review, at the Contractor's address given in the Agreement. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, Subcontractor shall submit a complete initial submittal including all components.

All submittals, regardless of origin, shall be stamped with the approval of Subcontractor and identified with the name and number of this Subcontract, Subcontractor's name, and references to applicable specification paragraphs and Subcontract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data. Building and electrical design plans shall bear the seal of an appropriately disciplined, Pennsylvania licensed professional engineer.

Subcontractor shall be solely responsible for the completeness of each submission. Subcontractor's stamp of approval is a representation to USEPA and Contractor that Subcontractor accepts sole responsibility for determining and verifying all quantities,

dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Subcontractor has reviewed and coordinated each submittal with the requirements of the Work and the Subcontract Documents.

All deviations from the Subcontract Documents shall be identified as deviations on each submittal and shall be tabulated in Subcontractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Subcontractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

Three copies of each drawing and necessary data shall be submitted to Contractor. Contractor will return one (1) marked copy to Subcontractor. Facsimile (fax) copies will not be acceptable. Contractor will not accept submittals from anyone but Subcontractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

7.02 Certificate of Compliance. Where indicated in the Subcontract Documents, each submittal shall include a certificate of compliance prepared by the manufacturer or supplier of the submitted data, certifying that the item covered is in compliance with the Subcontract Documents. The certificate of compliance shall be a separate document and shall include identification of all deviations from the Subcontract Documents.

7.03 Contractor's Review of Submittals. Contractor's review of submittals will cover only general conformity to the Drawings and Specifications, external connections, and dimensions which affect the layout. Contractor's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. Contractor's review shall not relieve Subcontractor of Subcontractor's sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Subcontractor's sole responsibility for compliance with the Subcontract Documents.

Contractor's submittal review period shall be 14 consecutive calendar days in length and shall commence on the first calendar day immediately following the date of arrival of the submittal or resubmittal in Contractor's office. The time required to mail the submittal or resubmittal back to Subcontractor shall not be considered a part of the submittal review period.

When the drawings and data are returned marked "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the corrections shall be made as noted thereon and as instructed by Contractor and two corrected copies (or one corrected reproducible copy) resubmitted. Facsimile (fax) copies will not be acceptable.

When the drawings and data are returned marked "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless requested by Contractor at time of review.

7.04 Resubmittal of Drawings and Data. Subcontractor shall accept full responsibility for the completeness of each resubmittal. Subcontractor shall verify that all corrected data and additional information previously requested by Contractor are provided on the resubmittal.

When corrected copies are resubmitted, Subcontractor shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by Contractor on previous submissions.

Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the resubmittal.

Resubmittals shall be made within 7 days of the date of the letter returning the material to be modified or corrected, unless within 2 days Subcontractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

Any need for more than one resubmission, or any other delay in obtaining Contractor's review of submittals, will not entitle Subcontractor to extension of the Contract Times unless delay of the Work is directly caused by a change in the Work authorized by a Change Order or by failure of Contractor to review any submittal within the submittal review period specified herein and to return the submittal to Subcontractor.

8.0 OPERATION AND MAINTENANCE PLAN AND MANUALS

The Subcontractor shall prepare and submit for Contractor approval (prior to completion of the Field Performance Test), an Operation and Maintenance Plan, providing a detailed description of activities required to monitor and maintain the integrity of the remedial activities. The plan will include a detailed schedule of when activities will be performed, site visit and inspection check lists/forms that personnel will complete, sample locations/frequencies and required analyses, report forms that will be included in monthly reports, site inspection and security, erosion control, site vegetation, etc. In addition, adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare an operation and maintenance manual for each type of equipment indicated in the equipment schedule section. Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the equipment schedule.

Operation and maintenance manuals shall include the following:

- a. Equipment function, normal operating characteristics, and limiting conditions.
- b. Assembly, installation, alignment, adjustment, and checking instructions.
- c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
- d. Lubrication and maintenance instructions and schedules.
- e. Guide to troubleshooting.
- f. Parts lists and predicted life of parts subject to wear.
- g. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
- h. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Subcontractor.

Manuals and other data shall be printed on heavy, first quality 8-1/2 by 11 inch paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 by 11 inches or 11 by 17 inches but shall remain legible without the aid of magnification. Where reduction is not practicable, larger drawings shall be folded separately and placed

in envelopes which are bound into the manuals. Each envelope shall bear suitable identification on the outside.

Three preliminary copies of each manual, temporarily bound in heavy paper covers bearing suitable identification, shall be submitted to Contractor prior to the date of shipment of the equipment. After review by Contractor, three final copies of each operation and maintenance manual shall be prepared and delivered to Contractor prior to placing the equipment in operation. Final manuals and all parts lists and information shall be assembled in substantial, permanent, three-ring or three-post binders. As much as possible, material shall be assembled and bound in the same order as specified, and each volume shall have a table of contents and suitable index tabs.

All material shall be marked with project identification, and inapplicable information shall be marked out or deleted.

9.0 LAYOUT DATA

Subcontractor shall keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Copies of such data shall be furnished to the Resident Project Representative for use in checking Subcontractor's layout as provided in the project requirements section. All such data considered of value to USEPA will be transmitted to USEPA by Contractor with other records upon completion of the Work.

10.0 CONSTRUCTION PHOTOGRAPHS

Subcontractor shall be responsible for the production of construction photographs as provided herein. Contractor shall designate the subject of each photograph.

Twenty photographs of the treatment building location, or pertinent features thereof, shall be taken before the commencement of Work at the site and promptly submitted to Contractor. The same views shall be rephotographed upon completion of all construction activities and submitted with Subcontractor's application for final payment. Additional photographs shall be made each month throughout the progress of the Work at such times as requested by Contractor, and submitted with Subcontractor's application for progress payment.

Photographs shall be taken at intervals of approximately 100 feet along the routes of the piperuns and along the alignment of the containment barrier before the commencement of Work, and promptly submitted to Contractor. The same views shall be rephotographed upon completion of construction activities on any section of the piperun or containment barrier, and submitted with Subcontractor's Application for Payment for Work on that section.

All photographs shall be produced by a competent photographer and shall be color photographs of commercial quality. Two 4 by 5 inch prints of each view shall be submitted, along with digital files of the pictures. Prints shall be mounted on linen with flap for binding or enclosed in clear plastic binders, and marked with the name and number of the Contract, name of Subcontractor, description and location of view, and date photographed.

Contractor shall transmit one copy of each photograph to USEPA.

End of Section

Section 01400 - QUALITY CONTROL

PART 1 - GENERAL

1-1. SCOPE

This section covers quality control (QC) sampling and testing services for performance of the Work.

1-2. GENERAL REQUIREMENTS

Subcontractor shall provide all QC sampling and testing services to determine compliance with the Subcontract Documents in accordance with this section.

Subcontractor shall perform sampling for chemical analysis in accordance with Specification Section 01605 - Sampling for Chemical Testing.

Prior to the beginning of field work, the Subcontractor shall submit a Construction Quality Control Plan (CQCP) to the Contractor for review and approval.

The measurement and payment for the work of this section shall be in accordance with Specification Section 01025 - Measurement and Payment.

PART 2 - EXECUTION

2-1. SAMPLING AND TESTING SERVICES

All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Contractor. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by Contractor are for the sole benefit of the Contractor and USEPA; however, tests results shall be available to Subcontractor. Testing necessary to satisfy Subcontractor's internal quality control procedures shall be the sole responsibility of Subcontractor.

2-1.01 Testing Services Furnished by Subcontractor. Unless otherwise specified, Subcontractor shall provide all testing services in connection with the following:

- Concrete materials and mix designs.
- Paving materials.
- Embedment, fill, and backfill materials.
- Moisture-density and relative density tests on embedment, fill, and backfill materials.
- In-place field density tests on subgrades, embedments, fills, and backfill.
- Pipe pressure testing.
- Prove out sampling and analysis of treatment system for discharge to the NPDES permitted outfall.
- All other prove out and periodic sampling and analysis of treatment system necessary for process monitoring purposes.
- All other tests and engineering data required for Contractor's review of materials and equipment proposed to be used in the Work.
- Chemical testing performed as specified in Section - 01605.

The frequency of all testing shall be sufficient to ensure that the requirements of Section 02200 - Earth Work, Section 11430-Groundwater Treatment Process System, Section 11710 - System Monitoring and Cleanup Verification, and all other applicable sections of these specifications are met in all phases of the project.

2-1.02 Construction Quality Control Plan. The Subcontractor shall submit a Construction Quality Control Plan (CQCP) to the Contractor for review and approval. The purpose of the CQCP is to define those testing activities that will be necessary to assure and document requirements stipulated in these subcontract documents are satisfied during construction. The CQCP shall include, but not be limited to, the following:

- Responsibility and authority;
- Personnel qualifications;
- Progress and problem meetings;
- Inspection activities and listing of all proposed tests/analysis with test methods;
- Testing frequencies;
- Identification of independent testing laboratories;
- Documentation and record keeping;
- Reporting requirements;

- Laboratory reports;
- Inspection Forms;
- Scheduling of testing;
- Sample locations;
- Certifications; and
- Acceptance of completed components.

Subcontractor shall obtain Contractor's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.

2-1.03 Testing Services Furnished by Contractor. Unless otherwise specified, Contractor will not conduct independent testing unless materials or workmanship are suspect.

Subcontractor shall furnish all sample materials not specifically related to permitting or groundwater monitoring requirements and shall cooperate in all testing activities, including sampling. Subcontractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Subcontractor shall have no claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by Contractor or the testing firm's laboratory personnel, Subcontractor shall furnish personnel and facilities to assist in the activities.

2-1.04 Transmittal of Test Reports. Written reports of tests and engineering data furnished by Subcontractor for Contractor's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings or required by Contractor.

The testing firm retained by Owner will furnish four copies of a written report of each test. Two copies of each test report will be transmitted to the Resident Project Representative, one copy to Contractor, and one copy to Subcontractor, within 3 days after each test is completed.

2-2. OFFSITE INSPECTION

When the Specifications require inspection of materials or equipment during the production, manufacturing, or fabricating process, or before shipment, such services will

be performed by Contractor or an independent testing firm or inspection organization acceptable to Contractor.

Subcontractor shall require the producer, manufacturer, or fabricator to arrange for and pay an independent organization to perform the inspection services specified.

Subcontractor shall give appropriate written notice to Contractor not less than 10 days before offsite inspection services are required, and shall provide for the producer, manufacturer, or fabricator to furnish safe access and proper facilities and to cooperate with inspecting personnel in the performance of their duties.

The inspection organization will submit a written report to Contractor, with a copy to Subcontractor, at least once each week.

2-3. MANUFACTURER'S FIELD SERVICES

An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the equipment schedule section (or are necessary to ensure compliance with equipment warranties) shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Contractor.

Each manufacturer's representative shall furnish to Owner, through Contractor, a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

End of Section

SECTION 01500 - TEMPORARY FACILITIES

PART 1 - GENERAL

1-1. SCOPE. This section covers temporary facilities as required for performance of the Work.

1-2. WATER AND POWER. All water and power required for and in connection with the Work shall be provided by and at the expense of Subcontractor. No separate payment for water or power used or required will be made and all costs in connection therewith shall be included in the Bid.

PART 2 - PRODUCTS

2-1. SANITARY FACILITIES. Subcontractor shall furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the project, including Contractor.

Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one (1) toilet shall be furnished for every 20 individuals. Subcontractor shall enforce the use of such sanitary facilities by all personnel at each property.

2-2. FENCES. Subcontractor shall furnish and install new fences where indicated on the Subcontract Drawings in accordance with Specification Section 02832 - Chain Link Fencing. All existing fences affected by the Work shall be maintained by Subcontractor until completion of the Work. Fences that interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. On completion of the Work, Subcontractor shall restore all fences to their original or better condition and to their original location.

Subcontractor shall furnish and install temporary security fencing around the work area at each property as necessary to prevent unauthorized access to the remedial activities. Security fencing shall be of a type and color that is highly visible, such as yellow or orange. Subcontractor shall remove security fencing after the Work is completed and the necessary erosion and sediment controls are in place and operational. Subcontractor shall handle and dispose of security fencing in accordance with Specification Section 01606 - Materials Handling and Disposal.

Prior to the start of Work, Subcontractor shall submit to Contractor manufacturer's data and design of the temporary security fencing, in accordance with Specification Section 01300 - Submittals.

2-3. CONSTRUCTION TRAILER. Subcontractor shall furnish and provide a construction trailer and associated equipment throughout performance of the Work for use by Subcontractor and Contractor. The location of the trailer will be determined by Contractor prior to the start of Work.

The construction trailer shall be equipped with electrical outlets, telephones, desks, interior lighting, locking doors, air conditioning, heating, windows, a folding conference table, 12 folding chairs, a fax machine, a black-and-white photocopier, computer for exclusive use of the Contractor, internet access, a digital camera, and a water cooler. Subcontractor shall furnish and pay for all necessary electrical service connections, electricity, telephone expenses, copier paper and toner, maintenance of copier and fax machine, water, and disposable cups for use within the trailer. Subcontractor shall coordinate connection of electrical service to the trailer with Connectiv Electric Company.

Subcontractor shall handle and dispose of all wastes and trash from the construction trailer on a weekly basis, in accordance with Specification Section 01606 - Materials Handling and Disposal.

Prior to the start of Work, Subcontractor shall submit to Contractor the manufacturer's data for the construction trailer and all appurtenant equipment to be furnished as specified herein.

PART 3 - EXECUTION

3-1. PARKING. Subcontractor shall provide and maintain suitable parking areas for the use of all construction workers, Contractor, and others performing work or furnishing services in connection with the project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, property owner's operations, or construction activities.

3-2. MAINTENANCE OF TRAFFIC. Subcontractor shall conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Subcontractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Subcontractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point.

3-3. NOISE CONTROL. Subcontractor shall take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All construction machinery and vehicles shall be equipped with practical sound-muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

3-4. DUST CONTROL. Subcontractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant. When practicable, dusty materials in piles or in transit shall be covered by Subcontractor to prevent blowing.

3-5. POLLUTION CONTROL. Subcontractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance will be permitted to enter sanitary sewers, and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

3-6. DECONTAMINATION. Prior to the start of Work and arrival onsite, Subcontractor, at their own expense, shall thoroughly decontaminate their equipment and tools to be used to perform the Work. Decontamination shall consist of pressure washing to remove all encrusted soils, debris, grease, and oil.

Prior to the start of Work, Subcontractor shall submit to Contractor manufacturer's data and design of the decontamination station; and a decontamination plan addressing decontamination procedures, collection of decontamination materials and liquids, and the types of equipment to be used for decontamination. All submittals required by this section shall be in accordance with Specification Section 01300 - Submittals.

Subcontractor shall furnish and construct a decontamination station at each property. Subcontractor shall design, construct, and operate the station to contain and collect all materials generated during decontamination including, but not limited to, liquids, soils, mud, grease, and oils. Subcontractor shall sample collected decontamination materials and have a chemical analysis performed in accordance with Specification Section 01605 - Sampling for Chemical Testing. Based on the test results, Subcontractor shall handle and dispose of decontamination materials in accordance with Specification Section 01606 - Materials Handling and Disposal.

Prior to demobilization from the Site and prior to moving between properties, Subcontractor shall decontaminate all equipment and tools used to perform the Work in accordance with the Site Health and Safety Plan. Subcontractor shall perform all decontamination at the decontamination station to the satisfaction of Contractor prior to leaving each property.

End of Section

SECTION 01605

SAMPLING FOR CHEMICAL TESTING

PART 1 - GENERAL

1-1. SCOPE. This section includes all work necessary to perform sampling for chemical testing as required by the Subcontract Documents.

1-2. GENERAL REQUIREMENTS. Subcontractor will provide all quality control (QC) testing services in accordance with Specification Section 01400 - Quality Control. QC sampling for chemical testing will be performed by Subcontractor as specified herein, or otherwise directed by Contractor.

Contractor will provide quality assurance (QA) testing and chemical testing as necessary to verify Subcontractor's quality control program is effective.

1-3. REFERENCES. QA, QC and waste characterization sampling and chemical testing will be performed in accordance with the Subcontract Documents, USEPA guidance and all applicable rules, regulations, codes and ordinances of Local, State, and Federal Authorities including, but not limited to the Site Health and Safety Plan.

1-4. SUBMITTALS. Prior to the start of Work, Subcontractor will submit to Contractor a CQCP which, in addition to common construction physical testing, addresses sampling for chemical testing performed by Subcontractor. The CQCP should clearly define the methods by which Subcontractor will perform sampling including, but not limited to, sampling techniques; field documentation; equipment operation, calibration, and maintenance; sampling equipment; sampling locations; containerization; labeling; decontamination procedures; and protective clothing. The CQCP should also include, but not be limited to, personnel roles and responsibilities; data quality objectives; sampling process design; sample handling and custody requirements; instrument calibration; analytical methods; data review and verification; quality control requirements; reporting and documentation procedures; and equipment inspection, testing, and maintenance.

Prior to the start of Work, Subcontractor will submit to Contractor written reports of chemical analysis for each type and source of backfill material not originating from onsite (at least one sample per type and source of backfill), and a signed certification from

Subcontractor's independent laboratory attesting that the materials are noncontaminated in accordance with Local, State, and Federal regulations.

All submittals required by this section will be in accordance with Specification Section 01300 - Submittals.

PART 2 - PRODUCTS

2-1. MATERIALS. Subcontractor, at no additional cost to Contractor, will furnish all miscellaneous tools, equipment, and materials required to perform the work of this section.

PART 3 - EXECUTION

3-1. GENERAL. Subcontractor will cooperate in the sampling and testing activities. Subcontractor will furnish personnel and facilities, as necessary and at no additional cost to Contractor, to assist Contractor and Subcontractor's laboratory in sampling activities. Subcontractor will interrupt the Work when necessary to allow sampling and chemical testing to be performed. Subcontractor will have no claim for an increase in Subcontract Price due to such interruptions.

3-2. QC SAMPLING AND CHEMICAL TESTING. Subcontractor will furnish all QC sampling for chemical testing. In accordance with Specification Section 01400 - Quality Control, Subcontractor will arrange and pay all costs for independent laboratories to perform all QC chemical testing required by this section. Subcontractor will perform all work associated with sampling including, but not limited to, sample collection, labeling, containerizing, delivery to the laboratory, and cleanup.

3-2.01. Backfill and Fill Materials. Subcontractor will take at least one (1) representative sample of each type and source of backfill and fill material (from off-site sources) to be used as part of the Work. Subcontractor will have their independent laboratory perform the necessary QC chemical analysis of the samples to certify that the materials are noncontaminated in accordance with all applicable Local, State, and Federal regulations.

3-2.02. Monitoring/Extraction Well Samples. Contractor will take QC groundwater samples from each monitoring well and extraction well at a rate of one sample per well per quarter for during the first year that the treatment system is operational, and semiannually thereafter. Contractor will ship the collected samples to a preassigned Environmental Protection

Agency (EPA), Contract Laboratory Program (CLP) laboratory for QC groundwater analysis. All QC groundwater samples will be analyzed for target compound list (TCL) organic compounds and target analyte list (TAL) in accordance with the EPA CLP Statement of Work (SOW), OLM04.2 and ILM04.1 test methods respectively together all current revisions. Subcontractor shall be present for QC well sampling and shall provide all necessary assistance to Contractor personnel during the collection of these QC samples.

3-2.03. Treatment System Effluent. Contractor will take QC effluent samples from the outfall of the treatment system at a minimum frequency equal to that stipulated in the National Pollutant Discharge Elimination System (NPDES) permit for the treatment system. Subcontractor will have their independent laboratory perform QC treatment system effluent sample analysis. All QC treatment system effluent samples will be analyzed, at a minimum, for those constituents listed in that treatment system's NPDES permit. All analyses will be performed in accordance with the EPA, CLP, SOW, OLM04.2 or ILM04.1 (as appropriate) test method and all current revisions. Subcontractor shall be present for QC effluent sampling and shall provide all necessary assistance to Contractor personnel during the collection of these QC samples.

3-2.04. Treatment System Liquid Process Stream. Subcontractor will take QC samples from the liquid process stream of the treatment system at a minimum frequency to ensure proper functioning of the treatment system and timely changeouts of the liquid phase carbon units. Samples shall be collected from between the first and second liquid phase carbon units to determine breakthrough of the first unit and from other process stream locations as required by Contractor. Subcontractor will have their independent laboratory perform QC treatment system process stream sample analysis. All QC treatment system liquid process stream samples will be analyzed, at a minimum, for TCL organics. All analyses will be performed in accordance with the EPA, CLP, SOW, OLM04.2 test method and all current revisions.

3-2.05. Treatment System Vapor/Air Process Stream. Subcontractor will take QC readings and samples from the vapor/air process stream of the treatment system at a minimum frequency to ensure proper functioning of the treatment system, compliance with treatment system air permits, and timely changeouts of the vapor phase carbon units. Photoionization detector readings shall be taken before the first vapor phase carbon unit, between the first and second vapor phase carbon units, and after the second vapor phase carbon unit. Subcontractor will have their independent laboratory perform QC treatment system process stream sample analysis. All QC treatment system liquid process stream samples will be

analyzed, at a minimum, for TCL organics. All analyses will be performed in accordance with the EPA, CLP, SOW, OLM04.2 test method and all current revisions.

3-3 DISPOSAL. Subcontractor will handle and dispose of all excess materials generated as a result of all sampling in accordance with Specification Section 01606 - Materials Handling and Disposal.

End of Section

SECTION 01606 - MATERIALS HANDLING AND DISPOSAL

PART 1 - GENERAL

1-1. SCOPE

This section covers all labor, materials, equipment, and services necessary to handle, prepare, containerize, store, transport, pretreat, and dispose of all waste materials generated during performance of the Work.

1-2. GENERAL REQUIREMENTS

Subcontractor shall provide all labor, materials, equipment, and services necessary for handling, size reduction, loading, containerization, onsite storage, transportation, pretreatment, and disposal of waste materials resulting from performance of the Work.

Waste materials shall be defined as all contaminated and non-contaminated materials that result from and are not reused during performance of the Work. Waste materials shall include, but not be limited to, soil, debris, liquids, protective clothing, and equipment. Waste materials requiring offsite pretreatment and disposal, shall be as designated by Contractor.

Under no circumstances shall Subcontractor allow drainage of storm water from waste handling activities to enter any watercourse, storm drain, or sanitary sewer. In accordance with Specification Section 02270 - Erosion and Sediment Control or as directed by Contractor, Subcontractor shall furnish and construct berms or other means as necessary to divert runoff from entering clean work areas or adjacent properties.

The measurement and payment for the work of this section shall be in accordance with Specification Section 01025 - Measurement and Payment.

1-3. REFERENCES

Subcontractor shall perform all work of this section in accordance with the Subcontract Documents, and all applicable rules and regulations, codes, and ordinances of Local, State, and Federal authorities including, but not limited to:

- A. Code of Federal Regulations (CFR), Title 40, Part 257, *Criteria for Classification of Solid Waste Disposal Facilities and Practices*.
- B. CFR, Title 40, Part 261, *Identification and Listing of Hazardous Waste*.
- C. CFR, Title 40, Part 262, *Standards Applicable to Generators of Hazardous Waste*.

- D. CFR, Title 40, Part 263, *Standards Applicable to Transporters of Hazardous Waste.*
- E. CFR, Title 40, Part 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.*
- F. CFR, Title 40, Part 265, *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.*
- G. CFR, Title 40, Part 266, *Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities.*
- H. CFR, Title 40, Part 268, *Land Disposal Restrictions.*
- I. CFR, Title 40, Part 302, *Designation, Reportable Quantities, and Notification.*
- J. CFR, Title 49, Part 107, *Hazardous Materials Program Procedures.*
- K. CFR, Title 49, Part 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements.*
- L. CFR, Title 49, Part 173, *Shippers - General Requirements for Shipments and Packagings.*
- M. CFR, Title 49, Part 178, *Specifications for Packagings.*
- N. Delaware Code, Title 7, Chapter 63, *Hazardous Waste Management.*
- O. Gross and/or axle weight limitations for the Department of Transportation of each applicable State.
- P. Site Health and Safety Program.

1-4. SUBMITTALS

Prior to the start of Work, Subcontractor shall submit to Contractor a plan including, but not limited to, the names, qualifications, and certifications for each hauling subcontractor, waste disposal facility, and waste pretreatment and disposal facility; the manner in which both contaminated and non-contaminated materials will be managed; spill contingencies; spill response materials; and copies of placards and labeling to be used for shipment.

Prior to the transportation of waste materials offsite, Subcontractor shall submit to Contractor copies of all transportation and disposal related shipping documents including, but not limited to, hazardous waste manifests, land disposal restriction notifications, and bills of lading.

Immediately following any required pretreatment and disposal of waste materials, Subcontractor shall submit to Contractor all weigh tickets from the treatment and disposal facilities. Contractor's receipt of weigh tickets will be required for payment of waste pretreatment and disposal as required by Specification Section 01025 - Measurement and Payment.

All submittals required by this section shall be in accordance with Specification Section 01300 - Submittals.

PART 2 - PRODUCTS

2-1. MATERIALS

Subcontractor shall furnish all miscellaneous tools, equipment, and materials required to handle, protect, separate, stockpile, containerize, store, label, transport, pretreat, and dispose of waste materials in accordance with the Subcontract Documents.

Subcontractor shall furnish all necessary spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be compatible with the type of waste materials being handled and shall be available at all times during which waste materials are being handled or transported.

PART 3 - EXECUTION

3-1. MATERIAL SEPARATION AND STOCKPILING.

Subcontractor shall separate and stockpile non-contaminated waste materials from contaminated waste materials, in areas approved by Contractor.

The Contractor will designate contaminated materials from non-contaminated materials for the purpose of separation and stockpiling only. Subcontractor shall provide the necessary quality control (QC) sampling and chemical analysis in accordance with the Subcontract Documents to determine the actual levels of contamination and appropriate disposal methods. Non-contaminated waste materials shall include, but not be limited to, trees, shrubs, fencing, concrete sidewalks, concrete slabs, macadam pavement, and steel underground storage tanks and associated piping. Contaminated waste materials shall include, but not be limited to, all materials excavated within the limits as indicated on the Subcontract Drawings and as directed by Contractor.

The Contractor will designate contaminated materials requiring pretreatment and disposal for the purpose of separation and stockpiling only. Subcontractor shall provide the necessary quality control (QC) sampling and chemical analysis in accordance with the Subcontract Documents to determine the actual levels of contamination and appropriate pretreatment and disposal methods.

Subcontractor shall protect non-contaminated materials from contaminated materials, as necessary, by lining with plastic sheeting and by constructing berms, or other means acceptable to Contractor. Subcontractor shall construct and manage stockpiles to prevent erosion in accordance with Specification Section 02270 - Erosion and Sediment Control.

Subcontractor shall furnish materials to cover all waste materials throughout construction. Covers shall be heavy duty tarps or plastic sheeting with a minimum thickness of 6 mils, and prevent saturation by rainfall. Subcontractor shall furnish and secure stockpile covers with sandbags or equal as approved by Contractor.

3-2. MATERIAL CONTAINERIZING.

All waste materials designated for offsite disposal shall be sized and placed within containers by Subcontractor. Subcontractor shall organize the containerization of materials so as to maximize the handling and disposal efficiency and reduce the cost of the disposal operation.

Subcontractor shall reduce material sizes, load the containers, and manage the material water content to meet the requirements of the final disposal facility and agencies having jurisdiction over transportation and waste disposal. Subcontractor shall take all necessary precautions to avoid placing free water into containers used for soil or debris.

Subcontractor shall furnish tarps of sufficient size and strength to cover containerized materials and prevent saturation by rainfall. Prior to transportation offsite, Subcontractor shall sufficiently tie down the tarps to prevent loss of materials and dust.

3-3. ONSITE STORAGE.

Subcontractor shall be permitted to store waste materials onsite for no longer than 7 calendar days after completion of excavation at each property.

3-4. SAMPLING AND CHEMICAL TESTING.

In accordance with Specification Section 01400 - Quality Control, Subcontractor shall provide the necessary QC sampling and chemical analysis of waste materials to determine the levels of contamination and appropriate methods of pretreatment and disposal. Sampling and chemical testing of waste materials shall be performed in accordance with Specification Section 01605 - Sampling for Chemical Testing.

3-5. MATERIAL TRANSPORTATION AND DISPOSAL.

All vehicles used to transport waste materials shall have equipment to cover waste materials during transit. The disposal facilities must be approved by Contractor prior to transporting any waste materials offsite.

Upon submittal of waste material QC test results to Contractor, Subcontractor shall arrange for the transportation of all waste materials in a safe, efficient, and environmentally sound manner. Non-contaminated waste materials shall be disposed at an approved non-hazardous disposal facility.

Contaminated waste materials requiring disposal only shall be disposed at an approved RCRA hazardous waste disposal facility. Contaminated waste materials requiring pretreatment and disposal shall be pretreated and disposed at an approved RCRA treatment and disposal facility.

All personnel used by Subcontractor for waste transportation shall be certified in accordance with all applicable Local, State, and Federal regulations for transporting waste. Subcontractor shall advise equipment operators of contingency operations required in the event an accidental spill occurs, and shall complete the necessary reports of each incidence.

Subcontractor shall furnish and prepare all necessary shipping documents including, but not limited to, hazardous waste manifests, land disposal restriction notifications, bills of lading, and any other applicable Local or State documents required for transportation and disposal of waste materials.

Subcontractor shall appropriately dispose of waste materials in accordance with the applicable Local, State, and Federal regulations governing waste classification and pretreatment standards.

Non-contaminated waste materials that are not required for offsite disposal, as approved by Contractor, shall become Subcontractor's property and shall be removed from the site by Subcontractor prior to completion of the Work.

3-6. SPILL RESPONSE.

Subcontractor, at no additional cost to Contractor, shall respond to and appropriately handle any spill of waste materials which are in the custody and care of Subcontractor pursuant to the Subcontract Documents. Subcontractor shall comply with all applicable Local, State, and Federal requirements regarding spill incidents.

3-7. CLEAN-UP.

Subcontractor shall be responsible for providing a clean Work area throughout the construction. Solid debris dislodged from equipment onto roads or areas offsite shall be immediately collected and removed by Subcontractor.

End of Section

Section 01610 - GENERAL EQUIPMENT STIPULATIONS

PART 1 - GENERAL

1-1. SCOPE. All equipment furnished and installed under this Contract shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.

1-2. COORDINATION. Subcontractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Subcontractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1-3. MANUFACTURER'S EXPERIENCE. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

PART 2 - PRODUCTS

2-1. WORKMANSHIP AND MATERIALS. Subcontractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

2-2. LUBRICATION. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by EPA. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.

Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

2-3. ELECTRIC MOTORS. Unless otherwise specified, motors furnished with equipment shall meet the following requirements:

- a. Designed and applied in accordance with NEMA, ANSI, IEEE, AFBMA, and NEC for the duty service imposed by the driven equipment, such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.
- b. Rated for continuous duty at 40EC ambient, unless the application is well recognized for intermittent duty service as a standard industry practice.
- c. Insulated with a Class F insulation system and designed for a maximum Class B temperature rise at service factor load (80EC at 1.0 or 90EC at 1.15), or insulated with a Class H insulation system and designed for a maximum Class F temperature rise at service factor load (145EC at 1.0).
- d. Motors used in applications which exceed the usual service conditions as defined by NEMA, such as higher than 40EC ambient, altitude exceeding 3,300 feet, explosive or corrosive environments, departure from rated voltage and frequency, poor ventilation, frequent starting, or adjustable frequency drive applications, shall

be properly selected with respect to their service conditions and shall not exceed specified temperature rise limits.

- e. To ensure long life, motors shall have nameplate horsepower equal or greater than the maximum load imposed by the driven equipment and shall carry a service factor rating as follows:

<u>Motor Size</u>	<u>Enclosure</u>	<u>Service Factor</u>
Fractional hp	Open	1.15
	Other Than Open	1.0
Integral hp	Open	1.15
	Other Than Open	1.0

- f. Designed for full voltage starting.
- g. Designed to operate from an electrical system that may have a maximum of 5 percent voltage distortion according to IEEE 519.
- h. Clamp-type grounding terminal shall be inside motor conduit box.
- i. External conduit boxes shall be oversized at least one size larger than NEMA standard.
- j. Totally enclosed motors shall have a continuous moisture drain which also excludes insects.
- k. Bearings shall be either oil or grease lubricated.
- l. Manufacturer's standard motor may be supplied on appliances, tools, and unit heaters, in which case a redesign of the unit would be required to furnish motors of other than the manufacturer's standard design. However, in all cases, totally enclosed motors are preferred and shall be furnished if offered by the manufacturer as a standard option.
- m. Totally enclosed motors shall be furnished on:
 - (1) Outdoor equipment.
 - (2) Equipment for installation below grade.

- (3) Chemical feeding and chemical handling equipment.
- (4) Equipment operating in wet or dust-laden locations.
- n. Drip-proof motors, or totally enclosed motors at the Supplier's option, shall be furnished on equipment in indoor, above-grade, clean, and dry locations.
- o. Explosion-proof or submersible motors shall be furnished as required by applicable codes or as specified in other sections.
- p. Motors shall be rated as follows:
 - (1) Below 1/2 hp.
115 volts, 60 Hz, single phase; or 240 volts, 60 Hz, single phase.
 - (2) 1/2 hp and above.
460 volts, 60 Hz, 3 phase.

Where specified or required by the Drawings, motors used on 240 volt systems shall be 230 volts, 60 Hz, 3 phase. Motors used on 208 volt systems shall be 200 volts, 60 Hz, 3 phase.

- q. All motors shall meet the minimum efficiency standards required by the Energy Policy Act (EPACT) of 1992.

2-4. DRIVE UNITS. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

2-4.01. Gearmotors. Unless otherwise specified, the use of gearmotors will not be acceptable.

2-4.02. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA

Class II. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable AGMA standards.

The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100EF above the ambient air temperature in the vicinity of the unit and shall not exceed 200EF.

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

2-4.03. Variable Speed Drives. Each mechanical variable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor. A spare belt shall be provided with each variable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

2-4.04. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.6 at maximum speed based on the nameplate horsepower of the drive motor.

2-5. SAFETY GUARDS. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be

fabricated from 16 USS gage or thicker galvanized or aluminum-clad sheet steel or from 1/2 inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

2-6. ANCHOR BOLTS. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with the anchor bolts and expansion anchors section and, unless otherwise specified, shall be at least 3/4 inch in diameter.

Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

2-7. EQUIPMENT BASES. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the grout section.

2-8. SPECIAL TOOLS AND ACCESSORIES. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2-9. SHOP PAINTING. All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished

with an oil-resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer. Unless otherwise specified, the shop primer for steel and iron surfaces shall be Ameron "Amercoat 180 Synthetic Resin Coating," Carboline "888 Primer," or Tnemec "Series 37H Chem-Prime H.S."

Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344."

2-10. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Contractor. Grease and lubricating oil shall be applied to all bearings and similar items.

Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

PART 3 - EXECUTION

3-1. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weather-tight structures maintained at a temperature above 60EF. Equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

3-2. INSTALLATION AND OPERATION. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results. When so specified, or when employees of Subcontractor or its lower-tiered subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.

Qualified field representatives shall be provided by each equipment manufacturer as required to perform all manufacturers' field services called for in the Specifications. Manufacturers' field representatives shall observe, instruct, guide, and direct Subcontractor's erection or installation procedures, or perform an installation check, as required. Each field representative shall revisit the site as often as necessary to attain installation satisfactory to Contractor.

All equipment installed under this Contract shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activities shall be provided.

3-3. OBSERVATION OF PERFORMANCE TESTS. Where the Specifications require the presence of Contractor, initial tests shall be observed or witnessed by Contractor.

End of Section

Section 02150

WELLS

PART 1 - GENERAL

1-1. SCOPE. This section covers the construction of eight (8) recovery wells and five (5) monitoring wells at locations as indicated on the subcontract drawings.

The Work includes the furnishing by the Subcontractor of all management, supervision, labor, equipment, tools, materials, supplies, services, and the payment of all taxes and other costs incidental to performance of well installation, pilot hole advancement/sampling and construction-derived waste management. The Subcontractor shall procure all permits, licenses, and certificates that may be required of him by law for the execution of Work herein. The Subcontractor shall comply with all federal, state, and local laws, ordinances, rules, and regulations relating to the performance of the Work herein.

The Work under this section shall include but not be limited to the following:

- Providing all field supplies.
- Securing all necessary state and local permits and licenses for well installation/ completion.
- Providing electrical power and potable water, as required.
- Setting up a decontamination pad and providing decontamination materials and equipment.
- Locating all utilities at each location where drilling or digging will be performed before initiating the activity.
- Drilling borings for all wells and pilot holes using drilling rig capable of performing the type of drilling required herein in accordance with the location, size, and depth specified herein and as indicated on all subcontract drawings.
- Penetrating concrete or asphalt if encountered, or as required by the Contractor.
- Backfilling borings that are not completed as wells with grout as specified herein or as required by the Contractor.
- Furnishing and installing permanent well casing in accordance with the type and at the depth specified herein and as indicated on all subcontract drawings.
- Developing wells and providing a sufficient amount of polyethylene tubing for

development of each well.

- Furnishing and installing well head security enclosures at each well.
- Providing new or recycled 55-gallon U.S. Department of Transportation (DOT) UN1A-1 or 1A-2 open head drums or equivalent, as acceptable to the Contractor.
- Collecting, transporting, staging and off site disposal as required of solutions, fluids, soil cuttings, and contaminated clothing produced during drilling borings, well installation and development, and on-site treatment of decontamination solutions and well development fluids.
- Providing traffic protection systems.
- Restoring and cleaning the sites at the completion of the Work, as required by the Contractor.
- Completing required reports.

The Contractor will have a representative in the field while Work is being performed. The representative will observe the Work to determine, in general, if the Work is proceeding in accordance with the intent of the Subcontract Agreement. The representative will approve well locations; maintain a log of each well, check each soil sample and bore hole for volatile organic vapors using monitoring instruments as specified in the Construction Health and Safety Program (CHASP) for this site; authorize changes in the Work to be performed; and oversee the performance of the Work.

1-2. GENERAL REQUIREMENTS.

The Subcontractor shall furnish all labor, materials, and equipment required for installation of wells specified herein. All stainless steel pipe and screen shall be new and shall be National Sanitation Foundation (NSF) tested and approved. No solvents or lubricants shall be used before or during the installation of the wells. Joints shall not be formed using solvent welding or glue. All materials shall be decontaminated in accordance with the requirements of Section 3-3. Clean gloves shall be used when installing the riser pipe and screen. The riser pipe and screen shall not be allowed to touch the ground following decontamination and before installation. The wells shall be vertical.

1-2.01. Site Access. Access to the site and offsite locations where the Work will be performed or access is required will be provided by the USEPA and will be available so that Work can proceed as scheduled; however, the Subcontractor shall have written notification from the Contractor to proceed before entering areas where the Work will be performed or access is required.

1-2.03. Personal Protection Equipment and Safety Training. The Subcontractor shall provide

personal protection equipment for its employees.

A CHASP for all work is included in Appendix J. The Subcontractor and all of Subcontractor's employees and lower-tier subcontractors who will be engaged in field activities at the site shall read and comply with all terms of the CHASP. The CHASP identifies potential hazards, respiratory protection, protective clothing, decontamination procedures, emergency procedures, and other health and safety aspects required for the Work. Subcontractor personnel who will work on this project shall attend a one (1) hour safety briefing before beginning the work.

The Subcontractor shall provide a 20-pound ABC type fire extinguisher and one first aid kit equipped with an eye wash bottle on each drilling rig.

1-2.04. Site Conditions and Hydrogeology.

The SCD Site is located on Governor Lea Road, in an industrialized area located approximately three miles northeast of Delaware City in New Castle County, Delaware. Residential and commercial properties are located within one mile of the facility (to the west). The SCD facility was built on approximately 46 acres of farmland that was previously owned by the Diamond Alkali Company. The Diamond Alkali Company had previously purchased the land from the Tidewater Refinery Company. The SCD Site is bordered to the east by Occidental Chemical Company (formerly Diamond Shamrock Company) property, to the west by Air Products, Inc. and to the south by Governor Lea Road. Governor Lea Road separates the SCD Site from property owned by Motiva Enterprises, LLC (formerly Star Enterprises) and Conectiv (formerly Delmarva Power and Light). The SCD facility is approximately 1,000 ft south of Red Lion Creek.

The land between the SCD facility and the Red Lion Creek is wooded (trees typically less than 6 inches diameter). This area remains undeveloped with the exception of gravel roads (single lane), a sedimentation lagoon/basin, two soil piles, and other features constructed as part of past remedial activities. Near the Red Lion Creek and its unnamed tributary (located to the west of Air Products and the undeveloped area to the north of the facility), the terrain slopes sharply downward into wetlands areas surrounding these two water bodies.

The SCD facility is located on relatively flat land approximately 50 feet above mean sea level (MSL). With the exception of the area occupied by Air Products, elevations decrease rapidly to the west of the SCD facility, leveling out a few feet above MSL in the wetlands surrounding an

unnamed tributary of the Red Lion Creek. The area to the north of the facility is relatively flat, but it drops off sharply (to approximately MSL) as it nears the Red Lion Creek.

Surface water runoff from the facility drains primarily to the east and west. Eastern drainage is directed through a drainage ditch – referred to as the eastern drainage ditch in the Record of Decision (ROD) – that eventually empties into the Red Lion Creek. Western drainage travels off-site and down to an unnamed tributary of the Red Lion Creek via two main drainage features. The first is a drainage ditch that runs along Governor Lea Road in front of the Air Products facility. The second is an eroded gully – referred to as the western drainage gully in the Record of Decision (ROD) – located at the northwestern corner of the facility.

Geologic investigations conducted as part of the Remedial Investigation (RI) of the SCD Site found that the Site is located above the Potomac, Merchantville, and Columbia Formations in the Atlantic Coastal Plain Physiographic Province. The Columbia Formation – consisting largely of fine sand and medium sand and gravel – is the uppermost geologic unit found at the Site and ranges in thickness from approximately 41 to 74 feet. The Merchantville Formation (ranging in thickness from 0 to 21 feet) underlies the Columbia Formation but was absent from the central portion of the Site. This formation is predominantly composed of material ranging from gray micaceous clay to silty/sandy clay. The upper portion of the Potomac Formation – which underlies the Columbia and Merchantville Formations – consists largely of interbedded clay, silt, and sand and overlies a water-bearing sand unit referred to in the RI Report as the upper Potomac aquifer.

The soils underlying the SCD Site consist primarily of Matapeake silt loam interspersed with small areas of Sassafras sandy loam. In general, these are deep well-drained soils, which are susceptible to erosion on sloping areas.

The Columbia Formation provides the uppermost groundwater system in the SCD Site area. The RI Report states that groundwater elevations in this area largely mirror topographic elevations with groundwater flowing generally to the north towards the Red Lion Creek and the unnamed tributary located to the west/northwest of the SCD Site.

Based on available geologic data, the RI Report suggests that the upper portion of the Potomac Formation, together with the Merchantville Formation (where it exists), form a confining layer beneath the Site. This confining unit was determined to range between approximately 60 feet and approximately 70 feet in thickness. Underlying this confining layer is the water-bearing sand unit referred to above and in the RI Report as the upper Potomac aquifer. Using data from the RI and earlier investigations, it was determined that groundwater flow in this second aquifer occurs in a southeasterly direction.

As part of the RI, a comparison of hydraulic heads occurring in the Columbia and Potomac Formations was performed for the SCD Site area. The results suggest that an upward vertical hydraulic gradient exists in those areas immediately surrounding the Red Lion Creek and its unnamed tributary. Conversely, the comparison indicated the presence of a downward vertical hydraulic gradient in the upland areas of the Site.

According to the RI Report, while the Columbia Formation does serve as a water supply source on a regional basis, there are no potable water supply wells drawing from it in the immediate area of the SCD Site. The RI Report does note that groundwater is drawn from the upper Potomac aquifer in the SCD Site vicinity.

1-3. SUBMITTALS. Drawings, specifications and data covering the proposed materials shall be submitted in accordance with the submittals section.

PART 2 - PRODUCTS

2-1. RECOVERY AND MONITORING WELL MATERIALS. Well materials for recovery wells shall be as described in the following subsections.

Drilling Mud	"Revert", or "SuperMud" Biodegradable Mud
55-gallon Drums	new or recycled U.S. Department of Transportation (DOT) UN1A-1 or 1A-2 open head drums or equivalent, as acceptable to the Contractor
Monitoring Well Casing (Riser)	2-inch ID NSF Schedule 40 304 Stainless Steel
Recovery Well Casing (Riser)	6-inch ID NSF Schedule 40 304 Stainless Steel
Monitoring Well Wire Wrapped Screen	2-inch Schedule 40 304 Stainless Steel, .020 in. slot
Recovery Well Wire Wrapped Screen	6-inch Schedule 40 304 Stainless Steel, .020 in. slot
Bentonite for Grout	Bentonite powder
Portland Cement	ASTM C150, Type II
Silica Sand	Morie Co. No.1
Bentonite Seal	3/8-inch diameter pellets, or Bariod Drilling Fluids, Inc. Holeplug graded bentonite chips, or bentonite powder

Monitoring Well Lockable Cap	Morrison Bros. Co. of Dobuque, IA Model 678XA
Recovery Well Cap	6-inch carbon steel capable of modification for pump control lines and discharge tubing
Monitoring Well Protective Casing	6-inch ID carbon steel with locking cap and 6-feet in length
Recovery Well Vault	Pre-cast concrete inside volume of 36" x 36" x 36" with 6-inch thick walls and a 36"x36" traffic rated (H-20), flush-mounted locking enclosure
Locks	Keyed alike American Weatherbuilt Model #702W

2-1.01. Submersible Pump. Each recovery well will be supplied with a submersible pump, tubing, and control cabling as discussed in *Specification 11210 Extraction Pump Specifications*.

2-1.02. Water. Water required for decontamination of equipment and mixing of grout shall be obtained by the Subcontractor from a potable water supply acceptable to the Contractor. The Subcontractor shall furnish all hoses and temporary storage tanks required to obtain, transport, and store the water. All water used shall be clean, potable, and free of oil, acids, organic materials, or other deleterious substances.

PART 3 - EXECUTION

3-1. SITE VERIFICATION. The Subcontractor shall locate all utilities at each boring location before initiating intrusive activities at any location. The Subcontractor shall not begin intrusive activities at any location until the location of utilities has been reviewed by the Contractor and the Contractor has issued authorization to proceed.

3-2. ROTARY WASH DRILLING. Rotary wash drilling shall include earth drilling, as required by the Contractor. Borings shall be a minimum of 10 inches in diameter to set the recovery wells and 6 inches in diameter to set the monitoring wells. The drilling equipment must be capable of advancing a 10-inch diameter borehole to 80 feet below ground surface.

All borings shall be drilled vertical, and shall be kept straight and plumb within limits that will permit satisfactory installation of pumps and controls. Should the boring or well prove unsatisfactory at any time prior to acceptance, the boring or well shall be considered abandoned.

Borings which are not completed as wells shall be backfilled with cement-bentonite. A new boring shall be started in the immediate vicinity at a location designated by the Contractor after the locations of utilities have been established by the Subcontractor.

Cuttings generated during advancement of the borings shall be collected on plastic sheeting at each drilling location and managed in accordance with the requirements of Section 3-8 of this specification. Water generated shall be drummed in accordance with the requirements of Section 3-8 of this specification.

The drilling equipment, casing, and materials required to perform the borings shall be decontaminated in accordance with Section 3-7 of this specification. Grease or other lubricants shall not be used on the drilling or sampling equipment, casing, or on tools required to perform the borings.

3-3. WELL CONSTRUCTION. Wells shall be constructed using materials described in Section 2-1 of this specification.

3-3.1. Riser Pipe and Screen The well riser pipe and screen sections shall be joined using flush threaded joints that are acceptable to the Contractor. The well screen shall be factory slotted. An NSF tested and approved 304 stainless steel flush threaded bottom cap shall be provided for the wells. The bottom cap for the well shall have a minimum of ten 0.01-inch diameter holes through the bottom of the cap.

3-3.2. Filter Pack Washed silica sand shall be used as backfill around the well screen and shall extend a minimum of 4 feet above the top of the screen section. The washed silica sand shall be placed in a slow, steady stream using gravity. However, if bridging occurs, the sand shall be tremied into place.

3-3.3. Bentonite Seal Directly above the silica sand shall be a nominal 2-foot bentonite pellet seal. If water is not present in the borehole, the bentonite shall be hydrated after placement by pouring clean potable water, from a source approved by the Contractor, in the hole and allowing the bentonite to set for at least 15 minutes prior to grouting.

3-3.4. Grouting Above the bentonite seal, the length of the annulus around the well shall be backfilled with cement-bentonite grout, to a level as shown on the Contract Drawings. A grout mixer shall be required to attain the 11 to 13 lbs. per gallon requirement. The grout mixer shall be decontaminated in accordance with requirements of Section 3-7 of this specification (grout mixers which are

constructed in a manner which positions the fuel source over the grout tub will not be permitted).

The cement-bentonite grout slurry shall weigh between 11 and 13 pounds per gallon and consist of 95 percent (by weight) cement with 5 percent sodium bentonite mixed with no more water than is required for proper placement. Cement shall conform to ASTM C 150, Type II. The grout shall be thoroughly mixed and shall be used before any stiffening occurs. The Subcontractor shall supply a balance to measure the weight of the grout.

Grout shall be placed by the tremie method. The tremie method shall consist of pumping the slurry down the boring or annular space outside the permanent casing through a pipe. The bottom of the pipe shall be placed near the bottom of the zone to be grouted and shall be raised as the grout is placed. The tremie pipe shall be maintained at a minimum of 5 feet below the grout surface during grout placement. Before grouting is completed, the Contractor will weigh the grout exiting the borehole to ensure correct mixture has been brought to the surface. Pumps, piping, and other materials for mixing and pumping grout shall be provided by the Subcontractor. Any unused grout that has remained in the mixing container may be used to top up newly installed well annular space within the same site. Left over grout shall be disposed of properly by the Subcontractor. Left over grout shall not be disposed of onsite.

3-3.5. Well Head Completion Vault enclosures, as described in Section 2 of this specification, shall be installed to protect the recovery wells. Vault enclosures shall be constructed according to requirements in the Subcontract drawings and shall be acceptable to the Contractor.

The recovery wellhead will be protected with a pre-cast concrete vault structure, which will be installed flush to the existing ground surface. The structure will rest on a 6-inch bed of modified 2A crushed stone. The structure will have an inside volume of 36" x 36" x 36" and will have 6-inch thick walls. The pre-cast vault will include openings for groundwater piping and control cables. Well vault design details are shown on **Drawing C-8**.

Each vault shall be provided with a 36"x36" traffic rated (H-20), flush-mounted locking enclosure to secure the wellhead, as indicated in the subcontract drawings. The flush-mounted enclosure shall consist of galvanized carbon steel and customized with a water tight gasket. The cover shall be designed so that a special tool is required to remove it. The Subcontractor shall provide the Contractor with two required tools to open and close the cover. The outside of the enclosure shall be primed and painted with two coats of rust inhibiting paint prior to bringing it onsite and shall be approved by the Contractor prior to installation. In addition, the Subcontractor shall permanently

label each well enclosure with the well number on the outer ring surface using a metal stamp and on the inside of the enclosure using a metal tag or other method approved by the Contractor.

Recovery wells and control cables shall be connected to conveyance systems and shall be finished as indicated on Subcontract drawings and specifications.

Each monitoring well shall be provided with a locking enclosure as shown on the Contract Drawings. Each monitoring well shall be provided with a locking enclosure constructed of materials listed in Section 2. All padlocks for all well enclosures shall be keyed alike. A structural concrete surface seal shall be placed as shown on the Contract Drawings. The concrete shall be finished with a smooth uniform surface using a trowel. A measuring point shall be marked onto the top of the riser. A lockable, watertight cap shall be provided for any well.

In addition, the Subcontractor shall permanently label all well enclosures with the well number on the outer surface using a metal stamp and on the inside of the enclosure using metal tags or other method approved by the Contractor. A structural concrete surface seal shall be placed as shown on the Contract Drawings. The concrete shall be finished with a smooth uniform surface using a trowel.

Before completing borings or wells, and when a borehole or well is unattended, it shall be secured to prevent introduction of any foreign material into the borehole.

3-4. WELL DEVELOPMENT. The goal of developing the recovery well is that each well will meet or exceed its designed capacity to transmit water from the aquifer and to reduce sediments in the borhole. The Subcontractor shall perform the well development and provide all of the necessary equipment to complete development, including submersible pump, hose, and surge equipment. The recovery wells will be developed by surging and purging water from the well until sediment has been removed from the well and the actual yield estimated for each well meets or exceeds the proposed design requirements of the remediation system. This will require estimating the specific capacity of the well during the initial purge session, following surging, and at as many intervals necessary to document that the specific capacity of each well has been maximized.

If specific capacity of a developed well is less than its designed capacity following two hours of successive purging and surging by the Subcontractor, the Contractor will determine whether development of the well will continue or is considered complete. The Contractor may require the Subcontractor to abandon wells in which yields are significantly less than their designed capacity.

During development of each well, the Subcontractor shall also record the readings (time, volume

purged, and turbidity) on the data sheet. The data sheet shall also include information on the length of time a well is purged and surged, estimated capacity and the type of development equipment used.

The Subcontractor shall submit a copy of each well development data sheet to Contractor's engineer. Development of recovery wells will be performed following the curing of the cement grout seal and before the completion of the well enclosure/vault. Development will not begin until a minimum of 24 hours has elapsed after installation of each well. The wells shall not be developed by removing the water using air lifting or any other method that may cause undesirable disturbances to the hydrologic regime around the well. The wells will be surged using a surge block. Use of the submersible pump or intake hose as a surge block will not meet the Contractor's approval.

3.5 ABANDONMENT. Boreholes or wells that are not completed by the Subcontractor or do not receive final approval from the Contractor will be abandoned with grout as specified in Section 2-1.02 of this specification.

All Delaware regulations regarding the abandonment of a borehole will be followed.

3-6. DECONTAMINATION. The Subcontractor shall construct a decontamination station within the site at a location designated by the Contractor. The decontamination station area shall be lined with plastic and shall be sloped to collect the water in one area of the decontamination station. Water collected at the decontamination station shall be managed in accordance with the requirements of Section 3-8 of this specification.

The soap used for decontamination shall be Liquinox produced by Alconox, Inc., or an equivalent approved by the Contractor.

3-7.01 Initial Decontamination. The initial decontamination shall be performed by the Subcontractor in two separate phases.

The first phase of initial decontamination shall be performed prior to mobilizing the equipment to the site. In the first phase of initial decontamination, the Subcontractor shall thoroughly clean the equipment required to drill the borings and to develop the wells and the materials for construction of the wells using a high-pressure wash with potable water to remove any encrusted soil, mud, or organic matter that may adhere to the equipment and well construction materials. This will include, but not be limited to, the drill rig, pumps, drill rods, drill bits, threads, sampling equipment, casing, riser pipe, screen, nylon retrieval cord, and other tools and materials required to perform the services.

The second phase of initial decontamination shall be performed with Subcontractor-provided equipment and materials at the decontamination station located at the site and shall be performed following mobilization of equipment and materials to the site and prior to performing any Services. The following decontamination procedure shall be used for the second phase of initial decontamination for sampling equipment and materials required to perform the Services (same equipment as discussed for first phase of initial decontamination) as directed by the Contractor:

- Wash drilling and sampling equipment and materials with a high-pressure steam cleaner using soap and potable water.
- Rinse all equipment and materials with a high-pressure steam cleaner using potable water.
- If grease or oil is observed on any drilling or sampling equipment that may come in contact with the soil, wash with pesticide grade isopropanol and allow to air dry.
- Rinse sampling equipment with distilled water and other equipment with a high-pressure steam cleaner and potable water.

All spent decontamination solutions from the second phase of initial decontamination shall be collected and managed by the Subcontractor in accordance with Section 3-8 of this specification.

3-7.02 Intermediate Decontamination. Intermediate decontamination shall be performed by the Subcontractor and shall be required to prevent cross contamination of samples, wells, and borings. Intermediate decontamination between wells and borings shall be performed at the decontamination station.

Intermediate decontamination of drilling equipment shall consist of the following:

- Wash drilling equipment with a high-pressure steam cleaner using soap and potable water.
- Rinse drilling equipment with a high-pressure steam cleaner using potable water.
- If grease or oil is observed on any drilling equipment, wash with pesticide grade isopropanol and allow to air dry.

- Rinse again with a high-pressure steam cleaner using potable water.

Intermediate decontamination of development equipment shall consist of the following:

- Wash with soap and potable water.
- Rinse with potable water.
- If grease or oil is observed on any drilling equipment, wash with pesticide grade isopropanol and allow to air dry.
- Rinse with distilled water.

All spent decontamination solutions shall be collected and managed by the Subcontractor in accordance with Section 3-8 of this specification.

Decontamination of drilling equipment between wells and borings shall include, but not be limited to, drill rods, drill bits, threads, hoses and pump for well development, and all other equipment and tools that might contaminate the soil, bedrock, or groundwater.

Decontamination of equipment between samples shall include, but not be limited to, the sampler and all other equipment that might be contaminated in the sampling process.

3-7.03 Final Decontamination. Final decontamination shall be required to prevent movement of contaminants to clean areas offsite and shall be performed prior to demobilizing the equipment offsite. Final decontamination shall be performed at the decontamination station within the site.

For final decontamination, the Subcontractor shall follow the decontamination procedure set forth for drilling equipment for intermediate decontamination, Section 3-7.02 of this specification. All spent decontamination solutions shall be managed by the Subcontractor in accordance with Section 3-8 of this specification. Final decontamination of equipment shall include, but not be limited to, the drill rigs, pumps, core barrels, drill rods, drill bits, threads, development equipment, and all other tools that might have been contaminated during performance of Services.

3-8. MANAGEMENT OF CONSTRUCTION-DERIVED WASTE. Construction derived waste

(CDW) (i.e., drill cuttings, fluids, plastic sheeting, contaminated disposable sampling equipment that cannot be reasonably decontaminated, and contaminated disposable health and safety materials) shall be segregated according to material type and placed in U.S. Department of Transportation (DOT)-approved UN1A-1 or 1A-2 55-gallon drums. Drums will be provided by Subcontractor in stages as needed. No payment will be made for unused drums. Drill cuttings shall be segregated according to location. Care shall be taken to exclude or remove any free liquid from drums designated for non-liquid waste.

Decontamination fluids, groundwater removed from wells during development and purging, and liquid source materials removed from source areas during sampling shall be placed in U.S. Department of Transportation (DOT)-approved UN1A-1 or 1A-2 55-gallon drums. Solid material shall not be added to drums designated for liquid disposal. When filling these drums, at least 6 inches of freeboard shall be allowed. These drums shall have a new gasket. At completion of filling, these drums shall be closed, tipped to a 45-degree angle to verify the presence of a leak-proof closure.

All drums shall be labeled by the Subcontractor, as directed by the Contractor. The drums shall be labeled with the data, project name, drum contents, and well or boring number.

The drums shall be staged onsite by the Subcontractor at a location designated by the Contractor. The drums shall be placed on pallets supplied by the Subcontractor. The drums shall be staged so drums in the middle of the staging area can be accessed by walking between the drums. The staged drums shall be covered with a tarp(s) supplied by the Subcontractor. The tarp(s) shall be heavy-duty and waterproof. The tarp(s) shall be secured by the Subcontractor in a manner acceptable to the Contractor to prevent the tarp(s) from blowing off the drums and allowing water to accumulate on the drums.

Liquid waste shall remain onsite for treatment using the proposed groundwater treatment facility to be constructed onsite. Drill cuttings from each location shall be sampled for chemical analyses as required in Section 01605. Soils which meet clean-up criteria, based on results of chemical analyses, can be reused and/or spread onsite at areas approved by the Contractor. Those that do not meet cleanup standards shall be sampled for waste characterization and disposed of as appropriate at the cost of the Subcontractor.

Descriptive data on the U.S. Department of Transportation (DOT)-approved UN1A-1 or 1A-2 55-gallon drums, the method of the collection of material, and the transport of the drums to the staging

area shall be submitted by the Subcontractor for review by the Contractor.

3-9. CLEANUP AND RESTORATION.

3-9.01. Cleanup. At the conclusion of the work at each boring location, the Subcontractor shall remove all equipment, tools, material, and supplies, and shall leave the site clean and clear of all debris. All earth cuttings and drilling fluid generated while advancing the borings, decontamination solutions, and groundwater from well development and purging shall be collected and managed as specified in Section 3-7 of this specification.

3-9.02. Restoration. The Subcontractor shall be responsible for any damage to existing structures or property because of its negligent operations, and shall repair or replace any such damaged structures or property to the satisfaction of the property owner.

The Subcontractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property that may be caused by transporting equipment, materials, or personnel to or from the site, boring, or well location. The Subcontractor shall make satisfactory and acceptable arrangements with the responsible individuals having jurisdiction over the damaged property concerning its repair or replacement.

3-10. DRILLING REPORT. During drilling and well installation, the Subcontractor shall prepare, on a daily basis, a detailed drilling report for each drill rig. The report shall include, but not be limited to, the following:

- Footage completed on each well or boring during each work shift, and method of drilling used.
- Summary of quantities of materials used to construct each well.

The detailed drilling report shall be prepared and maintained on a daily basis by the Subcontractor regardless of records and logs prepared by the Contractor.

The Contractor shall have access to the Subcontractor's drilling report at all times and one copy shall be signed by the Subcontractor's authorized representative and furnished to the Contractor for each day while the work is in progress.

End of Section

Section 02200 - EARTHWORK

PART 1 - GENERAL

1-1. SCOPE. This section covers earthwork and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the sampling, handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; construction of fills and embankments; surfacing and grading; and other appurtenant work.

1-2. GENERAL REQUIREMENTS. With reference to the terms and conditions of the construction standards for excavations set forth in the OSHA "Safety and Health Regulations for Construction," Chapter XVII of Title 29, CFR, Part 1926, the Subcontractor shall employ a competent person and, when necessary, a registered professional engineer, to act upon all pertinent matters of the work of this section.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Contractor. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment. No backfill, fill, or embankment materials shall contain ice or frozen soils.

The Subcontractor shall examine the site and review the available test borings data prior to submitting their proposal, taking into consideration all conditions that may affect their work.

The USEPA and Contractor will not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time the investigation was made.

1-3. REFERENCES. Subcontractor shall perform all work of this section in accordance with the Subcontract Documents, all applicable rules and regulations, codes, and ordinances of Local, State, and Federal authorities, and industry standards including, but not limited to:

- a. Occupational Safety and Health Administration (OSHA), CFR, Title 29, Part 1926, *Safety and Health Regulations for Construction*.

- b. American Society for Testing and Materials (ASTM), Standard C33, *Standard Specification for Concrete Aggregates*.
- c. ASTM, Standard D698, *Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)*.
- d. ASTM, Standard D1556, *Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method*.
- e. ASTM, Standard D2487, *Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)*.
- f. ASTM, Standard D2922, *Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)*.
- g. ASTM, Standard D3017, *Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)*.
- h. ASTM, Standard D4253, *Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table*.
- i. ASTM, Standard D4254, *Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density*.
- j. ASTM, Standard D4643, *Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method*.
- k. ASTM, Standard D5434, *Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock*.
- l. Contractor Construction Health and Safety Program.
- m. Subcontractor Site Health and Safety Plan.

1-4. SUBMITTALS.

1-4.01. Earthwork Data. Prior to the start of any earthwork, Subcontractor shall submit to Contractor test data and visual samples of all proposed embedment, backfill, base course, structural and granular fill materials; the resumes of the designated Competent Person and Professional Engineer; and an earthwork report including, but not limited to, a sequence of operations, sketches, calculations, and proposed methods of dewatering, excavation, backfill, and compaction. Visual samples of all proposed embedment, backfill, structural fill and

granular fill materials shall be submitted by Subcontractor in separate 16 ounce wide-mouth glass jars and labeled with source name, date collected, and date tested.

1-4.02. Erosion and Sediment Control Plan. Prior to the start of any earthwork, Subcontractor shall comply with all New Castle County and State of Delaware Erosion and Sediment Control (E&SC) regulations. The subcontractor shall prepare an E&SC Plan for submission to New Castle County that shall be submitted with other Building Permit applications. The plan will describe measures the Subcontractor will use during the RA construction to limit stormwater runoff from the site. All submittals required by this section shall be in accordance with Specification Section 01300 - Submittals.

PART 2 - PRODUCTS

2-1. MATERIALS

2-1.01. General. Contaminated materials from off-site sources shall not be used for embedment, backfill, structural or granular fill materials. Contaminated materials from onsite shall not be used for embedment, backfill, structural or granular fill materials except with prior approval of Contractor, Delaware Department of Natural Resources and Environmental Control (DNREC), and EPA . The designation of contaminated materials shall be made solely by the Contractor. Non-contaminated materials (and appropriately approved contaminated materials) derived from earthwork activities and meeting the requirements of this specification, as determined by Contractor, may be reused by Subcontractor. Subcontractor shall provide additional suitable materials from offsite sources to be used as embedment, backfill, structural fill, base course aggregate and granular fill materials.

2-1.02. Geotextile. Geotextile shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall be the Amoco 4551 geotextile, or equal.

2-1.03. Polyethylene Film. Polyethylene film shall be Product Standard PS17.

2-1.04. Granular Fills. Granular fill material shall be crushed rock or gravel; shall be free from dust, clay, and trash; and shall be graded 1-1/2 inch to No. 4 as defined in ASTM C33.

2-1.05. Granular Material. Granular material for compacted backfill shall comply with ASTM C33 and shall be coarse aggregate, size No. 467, No. 5, No. 56, or No. 57.

2-1.06. Graded Gravel. Gravel for compacted backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

2-1.07. Aggregate Base Course. Material for the preparation of sub-bases shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 1/2 inch	98 - 100
1 inch	72 - 100
1/2 inch	51 - 83
No. 4	35 - 60
No. 10	20 - 50
No. 40	10 - 34
No. 200	3 - 13

The gravel mixture and aggregate course shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2-1.08. Embedment Materials. Embedment for pipelines and conduits shall be pea gravel, crushed rock with rounded or sub-rounded particles, or clean sand meeting ASTM C33. Crushed rock with sharp edges which could cause significant scratching or abrasion of the pipe shall not be used. Embedment material shall contain no cinders, clay lumps, or other material which may cause pipe corrosion.

2-1.09. Structural Fill. Material which will provide support for building or structure foundations shall be gravel (G), sandy gravel (GS), or sand (S). The material shall be free of organic material, loam, wood, trash, and other objectionable material. The structural fill shall have the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
6 inch	100
No. 4	20 -95
No. 40	0 -60
No. 200	0 - 8

2-1.10. Access Road Aggregate. Material for the aggregate surfacing repairs shall be graded within the following limits and shall contain no clay lumps or organic matter.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1-1/2 inch	100
3/4 inch	60-100
No. 10	30-55
No. 60	8-35
No. 200	5-20

2-1.11. Geogrid. Geogrid shall be a woven fabric consisting of long chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene chloride, formed into a stable network such that the filaments or yarns retain their relative position to each other. The grid shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall

be the Amoco 4545 geotextile, or equal approved by Delaware Department of Transportation's Materials and Research Section.

2-2. TESTS. The following quality control (QC) tests will be required to ensure that all backfill, granular fill, structural fill, base course and embedment materials and their placement comply with requirements of the Subcontract Documents. The Subcontractor shall provide all of the QC sampling and testing for the following items, in accordance with Specification Section 01400 - Quality Control.

- a. Two (2) initial gradation/classification tests in accordance with ASTM D2487 for each type and source of embedment, fill, or backfill material. One (1) additional gradation/classification test in accordance with ASTM D2487 test for each additional 500 tons of each type and source of embedment, backfill and fill material.
- b. Two moisture-density (Proctor) tests in accordance with ASTM D698 for each type and source of embedment, fill, and backfill material proposed.
- c. At least two (2) in-place field density tests in accordance with ASTM D1556 or ASTM D2922 for each lift or for each 500 square feet of backfill placed, whichever is less. The Contractor will determine the location of field density tests. If additional field control tests are necessary, in the opinion of the Contractor, such tests shall be made by the Subcontractor at no additional cost to the Contractor.
- d. At least two (2) in-place field moisture tests in accordance with ASTM D3017 or ASTM D4643 for each lift or for each 500 square feet of backfill placed, whichever is less. The Contractor will determine the location of field moisture - tests. If additional field control tests are necessary, in the opinion of the Contractor, such tests shall be made by the Subcontractor at no additional cost to the Contractor.
- e. At least one (1) chemical analysis for each type and source of backfilling material in accordance with Specification Section 01605 - Sampling for Chemical Testing.

PART 3 - EXECUTION

3-1. SURFACE PREPARATION.

3-1.01. Pre-Excavation Survey. Prior to any excavation or site disturbance, Subcontractor shall perform a survey to field locate the areas of excavation as shown on the Subcontract Drawings.

3-1.02. Site Preparation. All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of the Subcontractor. This work shall also include the removal and satisfactory disposal of crops, weeds, and other annual growth; the removal and satisfactory disposal of fences, steps, walls, chimneys, column footings, other footings, foundation slabs, basements, other foundation components, signs, junked vehicles and other rubble and debris as necessary.

3-2. EXCAVATION.

3-2.01. General. Subcontractor shall perform excavations for every type of material encountered within the limits of excavation shown on the Subcontract Drawings and as delineated in the field by Subcontractor. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms if necessary. In no case shall excavation faces be undercut for extended footings. In no case shall footings, concrete walls, slabs, and foundations be undercut.

3-2.02. Excavation Procedures. During all onsite and offsite excavations, soils shall be visually inspected to determine potential areas of contamination. Excavated soils which can be visibly identified as contaminated shall be contained immediately and brought to the attention of the Contractor.

All contaminated soils shall be stockpiled on polyethylene sheeting (minimum thickness of 6 mils) or heavy duty impermeable tarps to prevent contamination to underlying surfaces/soils and covered with heavy duty tarps or polyethylene sheeting (6 mils). The Subcontractor

shall furnish and secure stockpile covers with sandbags or equal as approved by the Contractor.

Soils excavated that are not visibly identified as contaminated can be reused or spread on site or disposed off site. Soils which meet the clean-up standards or disposed off site per testing by the Contractor can be reused and/or spread onsite at areas approved by the Contractor.

Contaminated soils or wastes shall be kept segregated from clean soils. Contaminated soils or wastes shall not be used as backfill. Contaminated soils or wastes shall be transported to an onsite area designated by the Contractor.

Subcontractor shall handle all contaminated soils or wastes in a manner which minimizes wind and water erosion, leachate generation from rainfall and spillage. At a minimum, Subcontractor shall cover contaminated soils with plastic and secure plastic with sandbags. Spillage occurring during truck loading or transferring shall be minimized and cleaned/removed immediately.

Air emissions including fugitive dusts, organic vapors and odors shall be minimized.

3-2.03. Classification of Excavated Materials. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.04. Trench Excavation. Excavations shall be made to the grades/depths and lines shown on the Subcontract Drawings. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. 400 feet shall be the maximum length of open trench on any line under construction. Except where tunneling or directional boring is indicated on the Subcontract Drawings, is specified, or is permitted by the Contractor, all trench excavation shall be open cut from the surface.

- a. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe and the Subcontract drawings.

- b. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled and that the trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.
- c. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1-1/2 inches deep along each side of the trench and along the perimeter of cuts for structures.
- d. Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

3-2.05. Excavation and Replacement of Soil for Foundations. Excavation and replacement of soils in the building area shall be to the depth, grades and lines shown on the Subcontract Drawings. The excavation shall be made such that widths will give suitable room for construction of the structures, for bracing and supporting, pumping and draining. The bottom of the excavations shall be rendered firm and dry and in all respects acceptable to the Contractor.

- a. Excavating and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Exposed subgrades shall be proof rolled with at least two coverages/passes of suitable equipment. The Contractor may waive this requirement if, in his opinion, the subgrade will be rendered unsuitable by such compaction. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures as a result of inadequate excavation, dewatering, proof rolling, or other construction methods, shall be removed and replaced by structural fill or other approved materials as required by the Contractor at the Subcontractor's expense.

- b. Dewatering shall be such as to prevent boiling or detrimental under seepage at the base of the excavation as specified herein before. Dewatering shall be conducted to maintain water levels to a depth of 2 feet below the excavation bottom at all times.
- c. Excavation equipment shall be satisfactory for carrying out the work in accordance with the Specifications and Subcontract Drawings. In no case shall the earth be ploughed, scraped, or dug with machinery so near to the finished subgrade as to result in excavation of, or disturbance of material below grade. The last of the excavated material being removed shall be done with hand tools such as picks and shovels just before placing of concrete or working mat thereon.
- d. When excavation for foundations has reached prescribed depths, the Contractor shall be notified and he will inspect conditions. If materials and conditions are not satisfactory to the Contractor, the Contractor will issue instructions as to the procedures to be followed.
- e. During final excavation to subgrade level, Subcontractor shall take whatever precautions are required to prevent disturbance and remolding. Material which has become softened and mixed with water shall be removed. Hand excavation of the final 3 to 6 inches will be required as necessary to obtain a satisfactory undisturbed bottom. The Contractor will be the sole judge as to whether the work has been accomplished satisfactorily.
- f. Refill of the excavation shall be with structural fill placed and compacted as specified in section 7.03.1 - Structural Fill. Fill shall be placed for the entire depth of the excavation in the lifts specified and then re-excavated as necessary to place the foundations and utilities.

3-2.06. Roadway Excavation. Excavation for the roadways, drives, and parking areas shall conform to the lines, grades, cross sections, and dimensions indicated on the drawings and shall include the excavation of all unsuitable material from the subgrade. After shaping to line, grade, and cross section, the subgrade shall be backfilled and compacted to a depth of at least 12 inches to 95 percent of maximum density at optimum moisture content as determined by ASTM D698. This operation shall include any reshaping and wetting or

drying required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material. For the porous pavement at the Rogers site, no compaction will be allowed and no additional material will be removed or replaced.

3-2.07. Miscellaneous Excavation. The Subcontractor shall perform all remaining miscellaneous excavation. The Subcontractor shall make all excavations necessary to permit the placing of base material for constructing roadways, driveways, and any other miscellaneous earth excavation required under this Contract.

3-2.08. Preservation of Trees. No trees shall be removed outside excavated or filled areas, unless their removal is authorized by the USEPA. Trees left standing shall be adequately protected from permanent damage by construction operations.

3-2.09. Unauthorized Excavation. Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced, by and at the expense of the Subcontractor, with concrete placed at the same time and monolithic with the concrete above.

3-3. BACKFILL - PLACEMENT AND COMPACTION.

3-3.01. Structural Fill. Structural fill shall be placed in layers not to exceed eight inches in depth as measured before compaction. Each layer shall be compacted by a minimum of six coverages/passes with approved compaction equipment to at least 98 percent of maximum dry density as determined by ASTM D698. Incidental compaction due to traffic by construction equipment will not be credited toward the required minimum six coverages/passes.

3-3.02. Aggregate Base Course/Sub-base. Aggregate base course for road repairs shall be placed in layers not to exceed eight inches in depth as measured before compaction. Each layer shall be compacted by a minimum of six coverages/passes with approved compaction equipment to at least 95 percent of maximum dry density as determined by ASTM D698. Incidental compaction due to traffic by construction equipment will not be credited toward the required minimum six coverages/passes.

3-3.03. Trench Backfill - Compacted. Compacted backfill will be required for the full depth of the trench above the embedment material in the following locations:

- Beneath pavements, surfacings, driveways, curbs, gutters, and walks.
- In street, road, or highway shoulders.
- In established lawn areas.
- Where indicated on the Subcontract Drawings.

Granular fill as described above shall be used as backfill in these locations. The backfill shall be placed in layers not to exceed eight inches in depth as measured before compaction. Each layer shall be compacted by a minimum of six coverages/passes with approved compaction equipment to at least 95 percent of maximum dry density as determined by ASTM D698. Incidental compaction due to traffic by construction equipment will not be credited toward the required minimum six coverages/passes.

The top portion of backfill beneath established lawn areas shall be finished with at least 12 inches of topsoil corresponding to, or better than, that underlying adjoining lawn areas.

3-3.04. Trench Backfill - Uncompacted. Compaction of trench backfill above pipe embedment in locations other than those specified will not be required except to the extent necessary to prevent future settlement. The Subcontractor shall be responsible for backfill settlement as specified.

Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than 2 inches in diameter, debris, cinders, and any corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth.

Uncompacted backfill material above embedments shall be placed by methods which will not impose excessive concentrated or unbalanced loads, shock, or impact on installed pipe, and which will not result in displacement of the pipe.

Compact masses of stiff clay or other consolidated material more than 1 cubic foot in volume shall not be permitted to fall more than 5 feet into the trench, unless cushioned by at least 2 feet of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks or rock excavation detritus shall be placed in the upper 18 inches of the trench, nor shall any stone larger than 8 inches in its

greatest dimension be placed within 3 feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3-3.05. Pipe Embedment. Embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Each lift of embedment material shall be vibrated with a mechanical probe type vibrator during placement to ensure that all spaces beneath the pipe are filled. Each lift of embedment material shall be compacted with a platform type vibrating compactor to at least 70 percent relative density as determined by ASTM D4253 and D4254.

3-3.06. Granular Material. Granular material shall be provided where indicated on the drawings. Granular material shall be deposited in uniform layers not exceeding 12 inches in compacted thickness and shall be compacted to 70 percent relative density as determined by ASTM D4253 and D4254 with approved compaction equipment.

3-3.07. Granular Fills. Granular fills shall be provided where indicated on the drawings. Granular fills shall be placed on suitably prepared subgrades and compacted by vibration. Granular fills shall be compacted to not less than 70 percent relative density as determined by ASTM D4253 and D4254 with approved compaction equipment.

Where granular fills are to be covered with concrete, the top surface shall be graded to the required subgrade and covered with polyethylene film as specified in the concrete section.

3-3.08. Graded Gravel. Graded gravel backfill shall be provided where indicated on the drawings. Gravel backfill shall be deposited in uniform layers not exceeding 12 inches in uncompacted thickness. The backfill shall be compacted with a suitable vibratory roller or

platform vibrator to at least 70 percent relative density as determined by ASTM D4253 and D4254.

3-3.09. Moisture Control. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction but is otherwise satisfactory may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value. A barrier shall be placed around the stockpiled soils to prevent liquid flow from this area to dry areas.

3-4. DEWATERING. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12 inches or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

The Subcontractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

All water removed from excavations shall be considered contaminated. The Subcontractor shall provide and store all water in onsite containers as approved by the Contractor at such time until the onsite treatment system is 100% operational. The Subcontractor shall transfer the water from the onsite storage containers to the inlet of the treatment system at a rate not

to exceed the design flow of the treatment system. The Subcontractor is responsible for any required subsequent decontamination of the onsite water containers.

3-5. SHEETING AND SHORING. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported as necessary to prevent caving or sliding.

Trench sheeting may be removed only if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

Steel sheet piling shall be furnished, installed, and left in place as required to limit the extent of excavations for the deeper structures and necessary backfill under adjacent shallower structures, and to protect adjacent structures and facilities from damage due to excavation and subsequent construction.

3-6. STABILIZATION. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than 4 inches; if the required depth exceeds 4 inches, the material shall be furnished and installed as specified for granular fills. The finished elevation of stabilized subgrades shall not be above subgrade elevations indicated on the drawings.

3-7. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Subcontractor. Backfilling shall be done so that water will not accumulate in unfilled

or partially filled trenches. All material deposited in roadway ditches or other watercourses crossed by the line of trench shall be removed immediately after backfilling is completed, and the original section, grades, and contours of ditches or watercourses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3-8. PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other watercourses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds 1 percent, ditch checks shall be installed.

3-9. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-10. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of the work. If excavated material is considered contaminated, the Subcontractor shall perform the necessary waste characterization sampling prior to the transportation and disposal to the appropriate waste facility. Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work.

The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing, shall be a subsidiary obligation of the Subcontractor and no separate payment will be made therefor, except for disposal of contaminated material in an appropriate waste facility.

3-11. SEEDING/RESODDING. All established lawn areas cut by the line of trench or damaged during the work shall be resodded, after completion of construction, to the complete satisfaction of the property owner, Contractor and the USEPA per Specification Section 02930 - Seeding and Sodding.

All sodding shall be done during the period from March 15 to October 1, unless written permission is given by the Owner to extend the planting season.

3-12. SETTLEMENT. The Subcontractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions. The Subcontractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Contractor or the USEPA.

End of Section

Section 02202

TRENCHING AND BACKFILLING

Data Sheet

Para-graph	Description	Data	Units
	Performance and Design Requirements		
	Structure backfill outside manholes and small vaults.	<input checked="" type="checkbox"/> Same as trench backfill. <input type="checkbox"/> As specified in Section 02200.	
2-1.01	Types of filter fabrics.	<input checked="" type="checkbox"/> Type A. <input type="checkbox"/> Type B. <input type="checkbox"/> Other.	
2-1.11	Controlled low strength material (CLSM) required.	<input type="checkbox"/> Yes. <input checked="" type="checkbox"/> No.	
	Construction Requirements		
3-2.03	Blasting for excavation permitted.	<input type="checkbox"/> Yes. <input checked="" type="checkbox"/> No.	
	Limits of tree removal along pipeline routes.	<input type="checkbox"/> See the temporary facilities section under "Protection of Public and Private Property." <input checked="" type="checkbox"/> Other.	
	When "Other" is selected, indicate the alternative.	All embedded stumps, root mats, etc to be removed to a depth of not less than 2" below the subgrade or slope surface.	
	Minimum backfill depth over pipes below paved and graded streets.	12"	in. [mm]
	Minimum backfill depth over pipes in other locations.		in. [mm]
2-2.02 2-2.03 2-2.04	Responsibility for payment of field testing services.	<input checked="" type="checkbox"/> CONTRACTOR. <input type="checkbox"/> OWNER.	
3-2.01	Classification of excavated material.	<input checked="" type="checkbox"/> Unclassified. <input type="checkbox"/> Classified.	
3-2.04	Indicate dewatering depth below excavation.	<input checked="" type="checkbox"/> 12 inches [300 mm]. <input type="checkbox"/> 24 inches [600 mm]. <input type="checkbox"/> Other.	
	When "Other" is selected, indicate the alternative.		in. [mm]

	Materials		
3-6 2-1.03	Are there trenchless tunneled or bore and jack installations?	<input checked="" type="checkbox"/> Yes. <input checked="" type="checkbox"/> No.	
3-3.02	Maximum trench widths apply.	<input checked="" type="checkbox"/> Yes. <input checked="" type="checkbox"/> No.	
3-5.01	Compacted backfill materials.	<input checked="" type="checkbox"/> Suitable job excavated material. <input type="checkbox"/> Inundated sand. <input checked="" type="checkbox"/> Graded gravel. <input type="checkbox"/> Other	
	When "Other" is selected, indicate the alternate material requirements.		
	When "Other" is selected, indicate the locations for the alternate materials.		
3-5.04	Structure backfill.	<input checked="" type="checkbox"/> Same as compacted trench backfill. <input type="checkbox"/> As specified for structure backfill in Section 02200. <input type="checkbox"/> Other.	
	When "Other" is selected indicate material and compaction.		

Section 02202

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1-1. SCOPE. This section covers clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching; tunneled (trenchless construction) crossings; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other appurtenant work.

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, CONTRACTOR shall employ a competent person and, when necessary based on the regulations, a registered professional engineer, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with the submittals section.

1-3.01. Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted in accordance with the submittals section. Data submitted shall include:

A 12 inch square [300 mm] sample of fabric.

Manufacturer's descriptive product data.

Installation instructions.

1-4. BASIS FOR PAYMENT.

1-4.01. Trench Sheeting. No additional payment above the Contract Price will be made for trench sheeting left in place:

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01. Filter Fabric. The fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01. Filter Fabric Type A. Filter fabric Type A shall be provided for installation at locations indicated on the drawings and as specified herein. Filter Fabric Type A shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

Property	Test Method	Unit	Minimum Average Roll Value *
Fabric Weight	ASTM D3776	oz/yd ² [g/m ²]	5.7 [193]
Grab Strength	ASTM D4632	lb [N]	155 [689]
Grab Elongation	ASTM D4632	percent	50
Mullen Burst Strength	ASTM D3786	psi [MPa]	190 [1.3]
Apparent Opening Size	CW-02215	U.S. Standard Sieve Size	70 [212 µm]

* Minimum average roll value in weakest principal direction.

2-1.01.02. Filter Fabric Type B. Not used.

2-1.02. Vapor Barrier. Vapor barrier beneath concrete slabs or slab base course material shall be polyethylene film, Product Standard PS17, 6 mil [150 mm] minimum thickness.

2-1.03. Tunnel Liner Plates. Not used.

2-1.04. Smooth Steel Pipe. Not used.

2-1.05. Wood Skids. Not used.

2-1.06. Casing Insulators. Not used.

2-1.07. Stabilized Sand Backfill. Not used.

2-1.08. End Closure. Not used.

2-1.09. Inundated Sand Fill. Sand fill shall be clean, with not more than 25 percent retained on a No. 4 [4.75 mm] sieve and not more than 7 percent passing a No. 200 [75 µm] sieve, and shall have an effective size between 0.10 and 0.30 mm.

2-1.10. Graded Gravel Fill. Graded gravel for compacted trench backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch [25 mm]	100
3/4 inch [19 mm]	85 – 100
3/8 inch [9.5 mm]	50 – 80
No. 4 [4.75 mm]	35 – 60
No. 40 [425 µm]	15 – 30
No. 200 [75 µm]	5 – 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 [4.75 mm] sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2-1.11. Controlled Low Strength Material (CLSM) Fill. Not used.

2-1.12 Granular Fill. Granular fill material shall be crushed rock or gravel. Granular fill shall be free from dust, clay, and trash; hard, durable, nonfriable; and shall be graded 3/4 inch to No. 4 [19 to 4.75 mm] as defined in ASTM C33 for No. 67 coarse aggregate. Granular fill shall meet the quality requirements for ASTM C33 coarse aggregate.

2-2. MATERIALS TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in the quality control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of CONTRACTOR. Two initial gradation tests shall be made for each type of embedment, fill, backfill, or other material, and one additional gradation test shall be made for each additional 500 tons [450 Mg] of each material delivered to the site. In addition, one set of initial Atterberg Limits test shall be made for each fill materials

containing more than 20 percent by weight passing the No. 200 sieve [75 : m]. One additional Atterberg Limits test shall be made for each additional 500 tons [450 Mg] of each material delivered to the site.

All material testing on CLSM shall be made by an independent testing laboratory at the expense of CONTRACTOR.

2-2.02. Field Testing At Expense of OWNER. Not used.

2-2.03. Field Testing At Expense of CONTRACTOR. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of CONTRACTOR. CONTRACTOR shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.04. Required Tests. For planning purposes, the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as indicated in the submittals section.

- a. Two moisture density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, designated fill, backfill, or other material proposed.
- b. In-place field density and moisture tests at intervals of 1000 feet [300 m] maximum along the trench.
- c. One in-place field density and moisture test for every 200 cubic yards [153 m³] of backfill.
- d. One in-place density and moisture test whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.
- e. At least one test for every full shift of compaction operations on mass earthwork.
- f. Additional gradation, Proctor, and relative density tests whenever the source or quality of material changes.

PART 3 - EXECUTION

3-1. CLEARING. All clearing shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

3-2. EXCAVATION. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Except where exterior surfaces are specified to be dampproofed, monolithic concrete manholes and other concrete structures or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches [150 mm] clearance is provided for outside plastering.

3-2.01. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.02. Preservation of Trees. No trees shall be removed outside excavated or filled areas, unless their removal is authorized by OWNER. All embedded stumps, root mats, etc to be removed to a depth of not less than 2" below the subgrade or slope surface. Trees left standing shall be adequately protected from permanent damage by construction operations.

3-2.03. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.04. Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater

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level to the minimum depth of 12" beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

CONTRACTOR shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

CONTRACTOR shall obtain from the appropriate agencies and authorities, the dewatering and stormwater discharge permits required to remove and dispose of groundwater, surface water, and any other water used in CONTRACTOR's operations. The permits shall be obtained prior to start of construction.

3-2.05. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported with steel sheet piling and shoring as necessary to prevent caving or sliding.

Sheet piling or other excavation support systems shall be installed as necessary to limit the extent of excavations for deeper structures and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. CONTRACTOR shall assume complete responsibility for, and shall install adequate protection systems for prevention of damage to existing facilities.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered at the location of the project and retained by CONTRACTOR.

Trench sheeting may be removed if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, it shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Trench sheeting shall be removed unless otherwise permitted by ENGINEER. Trench sheeting will not be removed, if in the opinion of ENGINEER, removal of the sheeting will cause damage to the facility it is protecting. If left in place, the sheeting shall cut off 12 inches below finished grade. The design of the support system shall be such as to permit complete removal while maintaining safety and stability at all times.

3-2.06. Stabilization. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free

from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized subgrades shall not be above subgrade elevations indicated on the drawings.

3-3. TRENCH EXCAVATION. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. One hundred and fifty feet shall be the maximum length of open trench on any line under construction.

Except where tunneling is indicated on the drawings, is specified, or is permitted by ENGINEER, all trench excavation shall be open cut from the surface.

3-3.01. Alignment, Grade, and Minimum Cover. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe.

Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe as required. Greater pipe cover depths may be necessary on vertical curves or to provide adequate clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation, except where future surface elevations are indicated on the drawings.

3-3.02. Maximum Trench Widths. Maximum trench widths shall be limited as indicated on the contract drawings. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths from the bottom of the trench to an elevations 12 inches [300 mm] above the top of installed pipe, and the minimum permissible sidewall clearances between the installed pipe and each trench wall, shall be as indicated on the drawings.

Specified minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required to the trench excavation or the trench protective system.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than 12 inches [300 mm] above the top of the pipe.

If, for any reason, the width of the lower portion of the trench, as excavated at any point, exceeds the maximum permitted, pipe of adequate strength, special pipe embedment, or concrete arch encasement, for the applicable loading conditions and with the concurrence of ENGINEER, shall be furnished and installed by and at the expense of CONTRACTOR.

3-3.03. Minimum Trench Widths. Except when maximum trench width is required for certain conduits, trenches shall be excavated to the minimum trench widths indicated in the following table. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment.

<u>Nominal Pipe Size</u>	<u>Minimum Trench Width</u>	<u>Clearance</u>
Less than 27 in [700 mm]	Pipe OD plus 24 in [600 mm]	12 in [300 mm]
27 in through 60 in [700 mm through 1,500 mm]	Pipe OD plus nominal pipe size	ID/2
Greater than 60 in [1,500 mm]	Pipe OD plus 70 in [1800 mm]	30 in [750 mm]

Clearance = Minimum sidewall clearance
OD = Outside diameter (or span) of conduit
ID = Inside diameter (or span) of conduit.

Specified minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required to the trench excavation or the trench protective system.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits.

3-3.04. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, and that trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.

In locations where maximum trench widths are required for designated rigid conduits, mechanical equipment shall be operated so that uniform trench widths and vertical sidewalls are obtained at least from an elevation 12 inches [300 mm] above the top of the installed pipe to the bottom of the trench.

3-3.05. Cutting Concrete Surface Construction. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1-1/2 inches [40 mm] deep along each side of the trench and along the perimeter of cuts for structures.

Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 6 inches [150 mm] in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.

Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

3-3.06. Excavation Below Pipe Subgrade. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, as indicated on Figure 1-02202, to provide for the installation of granular embedment.

Bell holes shall provide adequate clearance for tools and methods used for installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

3-3.07. Artificial Foundations in Trenches. Whenever unsuitable or unstable soil conditions are encountered, trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable material. In such cases,

adjustments will be made in the Contract Price in accordance with the provisions of the General Conditions.

3-4. PIPE EMBEDMENT. Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the requirements indicated on Figure 1-02202 and to the following supplementary requirements.

Embedment material shall contain no cinders, clay lumps, or other material which may cause pipe corrosion.

3-4.01. Embedment Classes.

- a. Class A Arch Encasement. When arch encasement is indicated on the drawings, Class A arch encasement shall be used at all locations so indicated.

When arch encasement is not indicated on the drawings, Class A arch encasement is not required unless improper trenching or unexpected trench conditions require its use as determined by ENGINEER.

Concrete and reinforcing steel for Class A arch encasement shall conform to the requirements of the cast-in-place concrete section (03300P and 03300C).

- b. Class B Bedding. Class B bedding shall be used for all steel, ductile iron, pretensioned concrete, profile wall HDPE, PVC, ABS, FRP, and vitrified clay pipelines, and for all other pipelines not otherwise specified.
- c. Class C Bedding. Class C bedding shall be used for all reinforced concrete and prestressed concrete pipelines.

3-4.02. Embedment for Ductile Iron, Steel, FRP, and PVC Pipelines. Granular embedment for ductile iron, coal tar coated steel, FRP, and PVC pipelines shall be pea gravel or crushed rock with rounded or subrounded particles; crushed rock with sharp edges which could cause significant scratching or abrasion of the pipe or damage to the polyethylene tube protection shall not be used. Inundated sand may be used for granular embedment in locations where the use of water will cause no damage to adjacent property and where it can be placed and properly compacted without damage to the pipe.

Inundated sand for granular embedment shall be deposited in, or placed simultaneously with the application of water so that the sand is inundated during

compaction. During placement, the sand shall be compacted with a mechanical probe type vibrator. Water shall be allowed to escape or shall be removed during vibration, and no ponding shall be allowed to take place. Inundated sand shall be compacted to 70 percent relative density as determined by ASTM D4253 and D4254. If the required density cannot be achieved, placement and compaction methods shall be altered.

3-4.03. Placement and Compaction. Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof by shovel slicing or other suitable methods to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

Class C embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified and also around the restrained pipe sections.

Each lift of granular embedment material shall be vibrated with a mechanical probe type vibrator or shovel sliced during placement to ensure that all spaces beneath the pipe are filled. Granular embedment shall be placed in maximum lift thickness of 6 inches [150 mm] and compacted. Each lift of embedment material shall be compacted with three passes (round trip) of a platform type vibrating compactor.

Where indicated on the drawings, migration of soil into the embedment material shall be prevented with filter fabric Type A or by use of inundated sand embedment. Filter fabric shall be placed on the trench surfaces so that it completely surrounds the embedment material. Joints shall be lapped 12 inches [300 mm].

3-4.04. Groundwater Barrier. Continuity of embedment material shall be interrupted by low permeability groundwater barriers to impede passage of water through the embedment. Groundwater barriers for sewer lines that contain manholes with cast-in-place bases shall be compacted soil around each manhole, extending through any granular material beneath the manhole, and meeting ASTM D2487 soil classification GC, SC, CL, or ML-CL and shall be compacted to 95 percent of maximum density at near the optimum moisture

content (ASTM D698). Material may be finely divided, suitable job excavated material, free from stones, organic matter, and debris.

Groundwater barriers for sewer lines that contain manholes with precast (developed) bases and for all other pipelines shall be soil plugs of 3 feet [1 m] in width, extending the full depth and width of granular material, and spaced not more than 400 feet [120 m] apart. The soil plugs shall be constructed from soil meeting ASTM D2487 classification GC, SC, CL, or ML, and compacted to 95 percent of maximum density at near the optimum moisture content (ASTM D698).

3-5. TRENCH BACKFILL. All trench backfill above pipe embedment shall conform to the following requirements.

A layer of backfill material not more than 8 inches [200 mm] deep may be placed over concrete arch encasement or concrete reaction blocking after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement or blocking until the concrete has been in place for at least 3 days.

3-5.01. Compacted Backfill. Compacted backfill will be required for the full depth of the trench above the embedment in the following locations:

Where beneath pavements, surfacings, driveways, curbs, gutters, walks, or other surface construction or structures.

Where in street, road, or highway shoulders.

In established lawn areas.

The top portion of backfill beneath established lawn areas shall be finished with at least 12 inches [300 mm] of topsoil corresponding to, or better than that which is underlying adjoining lawn areas.

Trench backfill material shall be as required and as specified herein.

3-5.01.01. Job Excavated Material. Job excavated material may be used for compacted backfill when the job excavated material is finely divided and free from debris, organic material, cinders, any corrosive material, and stones larger than 3 inches [75 mm] in greatest dimension. Masses of moist, stiff clay shall not be used. Job excavated materials shall be placed in uniform layers not exceeding 8 inches [200 mm] in uncompacted thickness. Each layer of material shall have the best possible moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as needed and thoroughly mixed to ensure uniform moisture content and adequate compaction. Increased layer thickness may be permitted for noncohesive material if CONTRACTOR

demonstrates to the satisfaction of ENGINEER that the specified compacted density will be obtained. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. Job excavated material shall be compacted to 95 percent of maximum density at a moisture content within 2 percent of the optimum moisture content, as determined by ASTM D698 when that test is appropriate, or to 70 percent relative density as determined by ASTM D4253 and D4254 when those tests are appropriate.

3-5.01.02. Inundated Sand. Not used.

3-5.01.03. Graded Gravel. Gravel backfill shall be deposited in uniform layers not exceeding 12 inches [300 mm] in uncompacted thickness. The backfill shall be compacted with a suitable vibratory roller or platform vibrator to at least 70 percent relative density as determined by ASTM D4253 and D4254.

Groundwater barriers specified under pipe embedment shall extend to the top of the graded gravel backfill.

3-5.02. Ordinary Backfill. Compaction of trench backfill above pipe embedment in locations other than those specified will not be required except to the extent necessary to prevent future settlement. CONTRACTOR shall be responsible for backfill settlement as specified.

Ordinary earth backfill material to be placed above embedments shall be free of brush, roots more than 2 inches [50 mm] in diameter, debris, cinders, and any corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth.

Backfill material above embedments shall be placed by methods which will not impose excessive concentrated or unbalanced loads, shock, or impact on installed pipe, and which will not result in displacement of the pipe.

Compact masses of stiff clay or other consolidated material more than 1 cubic foot [0.03 m³] in volume shall not be permitted to fall more than 5 feet [1.5 m] into the trench, unless cushioned by at least 2 feet [600 mm] of loose backfill above pipe embedment.

No trench backfill material containing rocks or rock excavation detritus shall be placed in the upper 18 inches [450 mm] of the trench, nor shall any stone larger than 8 inches [200 mm] in its greatest dimension be placed within 3 feet [900 mm] of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3-5.03. Water-Settled Earth Backfill. Settlement or consolidation of trench backfill using water jetting or ponding shall not be performed.

3-5.04. Structure Backfill. Backfill around manholes and small concrete vaults shall meet the requirements specified for compacted trench backfill or structure backfill specified in Section 02200 as required.

3-5.05. Controlled Low Strength Material (CLSM). Not used.

3-6. TUNNEL EXCAVATION. Not used.

3-7. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by CONTRACTOR. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other watercourses crossed by the line of trench shall be removed immediately after backfilling is completed, and the original section, grades, and contours of ditches or watercourses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3-8. PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other watercourses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds 1 percent, or as otherwise required, ditch checks shall be installed. Unless otherwise indicated on the drawings, ditch checks shall be concrete. Ditch checks shall extend at least 2 feet [600 mm] below the original ditch or watercourse bottom for the full bottom width and at least 18 inches [450 mm] into the side slopes, and shall be at least 12 inches [300 mm] thick.

3-9. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches [100 mm]. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-10. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Disposal of excess material from trench excavations on plant and major facility construction sites shall be accomplished as indicated in the earthwork section of the specifications for the major construction.

Disposal of excess material from other trench excavation sites shall be as follows. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site.

Excess earth from excavations located in unimproved property may be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of 6 inches [150 mm] above the original ground surface elevation at and across the trench and sloping uniformly each way. Material thus wasted shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing, shall be a subsidiary obligation of CONTRACTOR and no separate payment will be made therefore.

3-11. RESODDING. All established lawn areas cut by the line of trench or damaged during the work shall be resodded, after completion of construction, to the complete satisfaction of the property owner and OWNER. All sod used shall be the same type as removed or damaged, shall be best quality, and, when placed, shall be live fresh growing grass with at least 1-1/2 inches [40 mm] of soil adhering to the roots.

All sod shall be procured from areas where soil is fertile and contains a high percentage of loamy topsoil and from areas that have been grazed or mowed sufficiently to form a dense turf.

Sod shall be transplanted within 24 hours from the time it is harvested, unless stacked at its destination in a suitable manner. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing. In no event shall more than 1 week elapse between cutting and planting.

Before placing sod, all shaping and dressing of the areas shall have been completed. After shaping and dressing, commercial fertilizer of a type

acceptable to OWNER shall be applied uniformly in the manner and amounts recommended by the manufacturer, and harrowed lightly. Sodding shall follow immediately.

All sodding shall be done during the period from March 15 to October 1, unless written permission is given by OWNER to extend the planting season.

3-12. SETTLEMENT. CONTRACTOR shall be responsible for all settlement of trench backfill which may occur within the correction period stipulated in the General Conditions.

CONTRACTOR shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from ENGINEER or OWNER.

End of Section

SECTION 02270 - EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1-1. SCOPE. This section covers erosion and sediment control and shall include furnishing, installing, and maintaining filter fabric fence, bituminous concrete diversion berms, and storm drain inlet protection as shown on the Subcontract Drawings and as necessary to prevent the transport of sediments and sediment laden water outside the limits of the Work area, and as required by Contractor.

1-2. GENERAL REQUIREMENTS. Subcontractor shall prevent erosion of soil on the Site and adjacent properties resulting from Subcontractor's construction activities. Subcontractor shall contain all sediment and sediment laden water within the property during performance of the Work.

Subcontractor will prepare and submit with a Delaware Department of Natural Resources and Environmental Control (DNREC) approved Erosion & Sediment Control (E&SC) Plan in accordance with the requirements to the Contractor. All site activities shall comply with the approved E&SC Plan for the Site.

The measurement and payment for the work of this section shall be in accordance with Specification Section 01025 - Measurement and Payment.

1-3. REFERENCES. Subcontractor shall furnish, install, and maintain erosion and sediment controls in accordance with the Subcontract Documents and all applicable rules and regulations, codes, and ordinances of Local, State, and Federal authorities including, but not limited to:

- A. DNREC, *Delaware Erosion and Sedimentation Control Handbook for Development*.
- B. Delaware Department of Transportation (DelDOT), Section 823, *Hot Mix, Hot Laid Bituminous Concrete*
- C. DelDOT, Section 809, *Emulsified Asphalt for Stabilization*.
- D. DelDOT, Section 827, *Geotextile*.

1-4. SUBMITTALS. Prior to the start of Work, Subcontractor shall submit to Contractor product data and drawings for filter fabric fence and all other erosion and sediment control materials.

Prior to the start of Work, Subcontractor shall submit to Contractor copies of all necessary building permits. All submittals required by this section shall be in accordance with Specification Section 01300 - Submittals.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be of sound quality and shall be in accordance with the *Delaware Erosion and Sedimentation Control Handbook for Development*.

2-1.01 Filter Fabric Fence.

Fabric	Meeting the requirements of DelDOT Section 827.02, woven geotextile.
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Support Stake	Minimum 30 inch long wooden or steel stake.
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2-1.02 Bituminous Concrete Diversion Berms.

Bituminous Concrete	Meeting the requirements of DelDOT Section 823.
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Tack Coat	Meeting the requirements of DelDOT Section 809.
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PART 3 - EXECUTION

3-1. GENERAL. Prior to the start of Work, Subcontractor shall be responsible for acquiring and preparing all necessary building permits from New Castle County, including an E&SC Plan for the Site. Subcontractor shall be responsible for maintaining and complying with the New Castle County and DNREC-approved E&SC Plans for the Site. Subcontractor shall contact the DNREC at (302) 739-4411 to coordinate plan submission and approval.

Subcontractor shall locate and mark lines, and relocate or bypass obstacles for construction of erosion and sediment controls. Subcontractor shall install filter fabric fence, bituminous concrete diversion berms, and other Contractor-approved measures as shown on the Subcontract Drawings and as necessary to contain runoff within the Work area, and as required by Contractor.

Subcontractor shall schedule the Work to expose areas subject to erosion for the shortest possible time, and to ensure the preservation of natural vegetation to the greatest extent practicable. Temporary storage and construction shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided by Subcontractor as necessary to control runoff.

3-2. FILTER FABRIC FENCE. Subcontractor shall fabricate filter fabric fence at each property or furnish a prefabricated fence provided it has been constructed with materials specified in DelDOT Section 251 and approved by the engineer. Filter fabric shall be attached to fence posts, spaced a maximum of 8 feet on center, with wire ties or staples. Fence posts shall be driven a minimum of 12 inches into the ground and filter cloth shall be embedded a minimum of 6 inches into the ground.

3-3. BITUMINOUS CONCRETE DIVERSION BERM. Diversion berms shall be a minimum of 12 inches high and constructed with side slopes of 1 horizontal to 1 vertical. The existing grade shall be dry and swept clean by Subcontractor prior to construction of bituminous concrete diversion berms. Subcontractor shall apply a bituminous tack coat beneath diversion berms.

3-4. STORM DRAIN INLET PROTECTION. Subcontractor shall wrap sewer grates, located in the vicinity of the Work, with filter fabric and place stone on the grate to secure the fabric and provide additional filtration as shown on the Subcontract Drawings and as directed by Contractor.

3-5. MAINTENANCE. Subcontractor shall maintain erosion and sediment controls throughout performance of the Work to contain sediment and sediment laden water within the Work area. Deficiencies identified by Contractor shall be immediately remedied by Subcontractor at no additional cost to Contractor.

3-6. REMOVAL AND DISPOSAL. Subcontractor shall remove and dispose of erosion and sediment controls after completion of the Work as directed by Contractor and in accordance with Specification Section 01606 - Materials Handling and Disposal.

End of Section

Section 02395 - HYDRAULIC BARRIER

1. SCOPE. This section covers construction of the hydraulic barrier wall and shall include the necessary excavation, trench support using bentonite slurry, backfill preparation, backfill placement, quality control testing and other appurtenant work required to successfully construct a low permeability subsurface barrier to groundwater flow as specified below.

2. GENERAL REQUIREMENTS.

2.01. General Barrier Wall Parameters. The barrier wall shall measure approximately 2500 linear feet in length, shall vary between 35 and 55 feet in depth (height), and shall be keyed 2 feet into the underlying low permeability layer as indicated on the drawings. The barrier backfill shall consist of soil-bentonite (SB) for approximately 1840 lf of barrier and soil-cement-bentonite (SCB) for approximately 460 lf of barrier. The barrier shall measure at least 36 inches in width, shall be vertical, and continuously encircle the designated area for contaminant plume management as specified in the Contract Documents, Section 02200, and this specification.

2.02. Subcontractor Qualification. The Subcontractor shall be experienced in slurry wall construction techniques. Experience shall include at least 500,000 SF of completed soil-bentonite (SB) barrier wall construction with at least two projects completed to depths in excess of the specified depths. Experience shall also included at least 100,0000 SF of completed SCB barrier construction. In addition, the Subcontractor shall have on staff a registered Professional Engineer experienced in slurry wall construction and quality control testing of slurry and SB/SCB backfill. The Subcontractor shall provide at least this minimum level of experience to acknowledge the design and construction sequence, construct a stable slurry trench, and provide a continuous low permeability barrier to groundwater flow. The Subcontractor shall supply the Contractor with written evidence of the required experience prior to award of the Work.

3. REFERENCES. The following references are applicable to the barrier wall construction and barrier quality control testing. Laboratory Testing procedures area described in Specification 02396.

3.01. American Society of Testing and Materials (ASTM) Standards.

C 143 Slump of Portland Cement Concrete.

C 150 Portland Cement

D 422 Particle Size Analysis of Soils.

- D 698 Test for Moisture Density Relations of Soils and Soil-Aggregate Mixture, Using 5.5 lbs. Hammer and 12 in. drop.
- D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.
- D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- D 4380 Standard Test Method for Density of Bentonitic Slurries.

3.02. American Petroleum Institute (API) Standard Specifications.

Code 13B Standard Procedure for Testing Drilling Fluid

Standard 13A Oil-Well Drilling Fluid Materials

3.03. Corp of Engineers Manual Series.

EM 1110-2-1906 Laboratory Soils Testing

EM 1110-2-3506 Grouting Technology

4. PRODUCTS. Subcontractor shall provide products as described below in quantities as required to allow successful completion of the barrier wall. Quality products shall be ensured by following established quality control protocol.

4.01. Bentonite. The Subcontractor shall provide a high yield untreated sodium montmorillonite (Wyoming bentonite), Federal 90 or equal, for use in slurry and any dry addition. The bentonite shall conform to the requirements set forth in API Specification 13A. The bentonite shall be protected from moisture and contact with other deleterious substances until used.

4.02. Slurry Make-up Water. Water used to make slurry shall be from a potable source and at least conform to the following criteria:

- a. pH greater than or equal to 7.0;
- b. Total dissolved solids not greater than 500 parts per million (ppm);
- c. Oil, organics, acids, alkali, or other deleterious substances not greater than 50 ppm; and
- d. Hardness less than 500 ppm.

Analysis of the make-up water sources shall be provided to the Contractor prior to mixing slurry.

4.03. Additives. No additives shall be used to modify the natural slurry properties.

4.04. Trench Slurry. Subcontractor shall provide a fully hydrated mixture of bentonite and water proportioned to yield the following properties:

- a. Filtration - 20 cc maximum by API 13B filter press test;
- b. Viscosity - Minimum of 40 seconds Marsh Funnel at 65 degrees F;
- c. Sand Content- Maximum of 15 percent based upon samples from the trench;
- d. Density - 70 to 85 pcf as required to maintain trench stability and allow backfill placement; and
- e. Conformance with all other manufacturer's recommendations.

4.05. Cement. The Subcontractor shall supply Type II Portland cement for preparing the SCB backfill. Cement preparation and use shall conform with ASTM C 150.

4.06. Soil-Bentonite (SB) Backfill. The Subcontractor shall supply soil-bentonite (SB) backfill consisting of excavated trench soils, slurry, imported fines as required, and the addition of dry bentonite. The backfill shall consist of a homogeneous blend of the ingredients. The backfill shall not contain particles greater than 2 inches in any dimension or contain fines with an organic content greater than 0.05 percent. SB backfill shall conform to the following criteria:

- a. Slump ranging from 4 to 6 inches;
- b. Moisture content ranging from 30% to 40%;
- c. Total fines (<#200 sieve) ranging from 20% to 40%;
- d. Density ranging from 85 to 110 pcf, and at least 15 pcf in excess of the density of the trench slurry; and
- e. Hydraulic Conductivity of 1×10^{-7} cm/sec or lower as measured in laboratory tests described in Specification 02396.

4.07. Soil-Cement-Bentonite (SCB) Backfill. The Subcontractor shall supply soil-cement-bentonite (SCB) backfill consisting of material as specified for conventional SB

backfill specified in 4.06 and as modified with the following criteria:

- a. Slump ranging from 4-8 inches;
- b. Cement content in excess of 7% by dry weight;
- c. Unconfined compressive strength in excess of 40 psi as measured in laboratory tests described in Specification 02396; and
- d. Hydraulic Conductivity of 5×10^{-7} cm/sec or lower as measured in laboratory tests described in Specification 02396.

5. EXECUTION.

5.01. General Requirements. The Subcontractor shall execute all aspects of the Work to provide a quality constructed barrier wall meeting the requirements of the technical specifications and quality control procedures.

5.02. Equipment. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the trench excavation bottom elevation can be controlled and that uniform trench widths and vertical sidewalls are obtained from the top of the trench to the bottom of the trench. Other Mechanical equipment used in trench excavation, mixing and backfill shall be of adequate type, design, and construction to ensure fully hydrated slurry, homogeneous backfill, uniform backfill placement, and yield a constructed product as defined in this and referenced specifications.

5.03. Working Platform. The Subcontractor shall construct an earthen berm to function as a working platform for construction of the barrier wall. The working platform shall be constructed to the lines and grades as defined on the Contract Drawings and to the requirements as outlined in the Earthfills and Embankments Section of Earthwork Specification 02200. Crane mats or timbering shall be used on the working surface to prevent rutting and sloughing. The working platform shall be graded to drain into the slurry trench to limit spillage.

5.04. Trench Excavation and Sequence. Trench excavation, and subsequent backfilling, shall first be completed in designated SCB areas identified below:

Station Range	
1+50 to 4+65	(range of full depth SCB backfill)
10+30 to 11+75	(range of full depth SCB backfill)

Subsequent trench shall be excavated starting at station 4+65 and proceed in a clockwise direction. The trench shall be excavated from the top of the platform, measure at least 36 inches in width, be keyed 2 feet into the underlying low permeability layer, and be free

and clear of any obstructions prior to backfill placement. Trench verticality shall be maintained. Trench excavation shall be performed so as not to spill slurry into any adjacent watercourse or drainage way. SCB excavation ranges shall be completed such that subsequent SCB backfill shall be full height within the specified ranges. Infill excavation for SB construction shall be performed to create a continuous barrier and uniform transition between SB and SCB backfill.

5.05. Trench Stability. The Subcontractor shall maintain trench stability by adjusting slurry head and density within the ranges of the parameters specified herein. Sufficient slurry shall be readily available to adjust trench slurry heights to respond to rising groundwater or adjacent high surface water conditions. Equipment live loading, other than excavation and backfill equipment, shall not be allowed adjacent to the open trench. Stockpile materials shall be placed a sufficient distance from the trench to maintain stability. Excavation equipment shall not be allowed to track back over the open trench.

5.06. Trench Slurry Sampling and Testing. Subcontractor shall perform periodic quality control testing of both the fully hydrated slurry before use in the trench and during use in the trench. Subcontractor shall provide experienced personnel to collect samples and perform such tests as required by the reference standards. Tests shall be performed at the site by the Subcontractor or the Subcontractor's independent laboratory as outlined below:

<u>Test</u>	<u>Frequency</u>
Viscosity	
As Mixed	Minimum of twice daily (minimum).
In Trench	At 10 feet below trench top, 5 feet above the trench bottom, and at an intermediate depth taken on 75 feet intervals; minimum of twice daily (start and end of day).
Filtrate Loss	
As Mixed	Minimum of 3 times weekly.
In Trench	At 5 feet above the trench bottom; minimum of twice daily (start and end of day).
Unit Weight	
In Trench	At 10 feet below trench top, 5 feet above the trench bottom, and at an intermediate depth

taken on 75 feet intervals; minimum of twice daily (start and end of day).

Subcontractor shall summarize and report results of testing to the Contractor on a daily basis.

5.07. Trench Limits. The barrier wall alignment shall be within one foot (\pm 6 inches) of the alignment as shown on the Contract Drawings. Verticality of the trench shall be maintained with an allowance for variations up to 2 percent of the total depth.

5.08. Trench Bottom. The trench shall be excavated to the target depth representing, a 2 foot key into the low permeability layer as shown on the Contract Drawings. The Subcontractor shall collect bottom samples for inspection by the Contractor to confirm the presence and depth of the low permeability layer prior to backfilling. Sample collection methods shall be acceptable to the Contractor. Bottom samples shall be collected by the Subcontractor at 20 foot intervals to confirm the target depth and trench bottom.

5.09. Backfill Mixing. Backfill shall be thoroughly mixed in the required proportions using dozers, scrapers, paddle mixers, diskers, or other suitable equipment to achieve the performance requirements of the specifications. Mixing can be performed adjacent to the trench (site interior) or at a central mixing location in the site interior as specified by the Subcontractor and approved by the Contractor. Mixing operations shall produce a homogeneous backfill. No backfill shall be mixed or placed during freezing temperatures or on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill. Backfill mixing shall be considered complete when backfill meets design and performance standards immediately prior to placement and is approved by the Contractor based upon testing requirements as defined in Specification 02396. Approved backfill shall not be modified prior to placement.

5.10. Backfill Placement. Backfill shall be placed only when the trench bottom and existing backfill slope have been approved by the Contractor. No backfill shall be allowed to free-fall in the trench slurry. Subcontractor shall utilize a lead-in trench, end-stop, and/or clamshell placement as approved by the Contractor to initiate backfill placement and eliminate free-fall. After initial placement, the Subcontractor shall place the approved backfill and push the previously placed backfill to move down the slope and remain free of slurry pockets, sloughing, or other deleterious material. In a continuous open trench, toe of the backfill slope shall be maintained between 50 and 125 feet from the toe of the trench excavation. The Subcontractor shall use a suitable guide trough and splash guards to control placement and minimize spillage.

5.11. Confirmation Sampling and Sounding. The excavated trench bottom shall be confirmed on a 20 foot interval as defined in Section 5.08. The backfill slope and exposed trench bottom shall be sounded for elevation by the Subcontractor to confirm stable

slopes and absence of undesirable material. Such soundings shall be made frequently and immediately prior to backfilling for approval by the Contractor. At a minimum the slope and bottom shall be sounded at least every 20 feet as outlined below:

- a. during the start of each work day;
- b. immediately prior to backfill placement in the area to be filled; and
- c. at the completion of each work day.

Confirmation soundings shall be provided to the Contractor upon collection and recorded on trench cross sections available to the Contractor.

Sampling to determine backfill properties shall be performed as defined by this Specification and Specification 02396.

5.12. Bottom Cleaning. The approved trench bottom shall remain free and clear of sediment buildup. The Subcontractor shall clean the trench bottom if sediment buildup, as determined by soundings, rises, above a limit of 6 inches higher than the approved trench bottom elevation.

5.13. Trench Closure. Trench closure shall be made at station 0+00 with suitable overlap to ensure continuity of the barrier backfill over the entire trench depth. The closure detail is dependent upon trench initiation and shall be submitted to the Contractor for approval.

5.14. Confirmation Borings. Borings shall be drilled through the completed backfilled trench to collect confirmation samples. Borings shall be completed on 250 foot centers with one sample collected for every five feet of drilling. Drilling, sampling, and reporting shall be performed according to Specification 02670.

5.15. Settlement Monitoring. The Subcontractor shall provide, install, and monitor 7 settlement plates to be placed on approximately 300 foot centers around the circumference of and directly above the barrier wall. Settlement plates shall consist plywood bases with galvanized pipe and be of a design acceptable to the Contractor. Plates shall be placed prior to placement of the Interim Clay Cap. Monitoring shall include an initial survey of horizontal and vertical positions, weekly elevation measurements for the first three months and monthly elevation measurements for the first year. Results shall be reported to the Contractor after each reading in a format acceptable to the Contractor.

5.16. Interim Clay Cap. The Subcontractor shall place a 2 foot thick clay cap over the completed backfilled trench as shown on the Contract Drawings. The exposed backfill shall not be subjected to the elements for greater than two days. Suitable temporary

cover material shall be placed over the backfill if site grading does not allow prompt placement of the interim clay cap. The clay cap shall be placed after the working platform is cut back as needed for site excavation and grading, and after initial backfill settlement occurs, as determined by the Contractor.

The clay cap shall be placed at a moisture content of at least two (2) percent above optimum. Compaction shall be carried out as described in the Earthwork section. The first lift of clay shall be placed in a 12 inch lift with the succeeding lifts placed as described in the Earthwork Section 02200. During the period of ten (10) working days after initial compaction, the area above the barrier wall shall be recompacted to develop and expose any possible depression in areas and to speed up settlement. If any sink should develop within the backfilled area, it shall be repaired by placing and compacting additional impervious material.

VEHICLE PASS-THROUGHS

5.17. Establishing Flow Zones. After completion of construction of onsite structures and backfill of onsite excavations, the Subcontractor shall excavate portions of the hydraulic barrier to reestablish groundwater flow between the containment area and surrounding area. The Subcontractor shall replace the hydraulic barrier backfill between **Stations 19+50 and 21+00 to 782 FT AMSL with permeable sand and gravel.**

The width of excavation shall include at a minimum the width of the backfill plus an additional four (4) feet on both sides of the excavation. The adjacent completed barrier wall shall be protected with sheeting or other means acceptable to the Contractor during excavation. Excavation shall conform to the general procedures as defined in Earthwork Specification 02200. Alternate trenching methods, including biopolymer methods will be considered by the Contractor. Upon satisfactory completion and confirmation of excavation, the flow zone shall be backfilled with SP, GP or GW soils as made available by the Subcontractor from other onsite excavations. The granular backfill material shall be maintained free and clear of deleterious material and be placed in such a manner to avoid mixing with additional fines and segregation of granular material

The Subcontractor shall submit methods and procedures of construction to the Contractor for approval prior to replacing portions of the barrier wall with permeable material.

6. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Insofar as possible, suitable excavated materials shall be used in the trench backfill and for fills to raise the site to final constructed elevations. Unsuitable material shall be disposed offsite consistent with Specifications 01605 and 01606.

6.01. Disposal of Bentonite Slurry. The Subcontractor shall sample the bentonite slurry at the completion of backfilling prior to final displacement consistent with Specification 01605 for the Contractor's review. Upon approval the final slurry shall be displaced to a

suitable location on the site and mixed with Type II Portland Cement, or other acceptable stabilizing additives, to achieve physical soil properties for use onsite as approved by the Contractor.

7. DRAINAGE MAINTENANCE. Surface drainage shall not be obstructed longer than necessary. Controlling and maintaining surface drainage shall be the responsibility of the Subcontractor throughout the construction.

8. QUALITY CONTROL. The Subcontractor shall provide adequate construction quality control to ensure the constructed product meets or exceeds the design and performance criteria of the Contract Documents. Quality control shall be performed by the Subcontractor's laboratory or an independent third party laboratory secured by the Subcontractor and experienced in such testing. Quality control testing procedures are as defined herein and in Specification 02396.

The Subcontractor shall maintain neat and orderly quality control documentation and shall make such information available to the Contractor upon request.

9. QUALITY ASSURANCE. The Contractor will perform quality assurance inspection and testing as deemed necessary. The Subcontractor shall assist the Contractor during sample collection for such testing. Results of such testing will be available to the Subcontractor upon request.

10. SUBSURFACE CONDITIONS. The subsurface conditions along the barrier wall alignment as shown on the contract drawings are based upon interpretation of discrete boring locations (located on approximately 150-200 foot centers, within approximately 50 feet of the barrier centerline). The Contractor is not responsible for differences between the interpretation and actual stratigraphy. The Subcontractor shall perform additional borings as shown on the Contract Drawings and defined below:

Boring	Depth	Location	
		North	East
BSB-1			
BSB-2			
BSB-3			
BSB-4			

The Subcontractor may choose to complete additional borings along the alignment prior to barrier construction. All drilling shall conform to Specification 02670 and be logged by a qualified geologist or geotechnical engineer retained by the Subcontractor. Delaware Department of Natural Resources and Environmental Control (DNREC) Boring Logs (or acceptable equivalent) shall be used to record all pertinent data and shall be submitted to the DNREC, and a copy forwarded to the Contractor.

11. SURVEYING. Surveying for elevation control for barrier construction shall conform to surveying requirements outlined in the Contract Documents. In addition to intermediate elevations and settlement monitoring specified herein, the Subcontractor is required to provide a final as-built survey of the barrier centerline and surface elevation.

12. Drawings and Data. Detailed drawings and data shall be submitted to the Contractor in accordance with the Submittals Section.

12.01. Submit Prior to Award of Work. Subcontractor shall supply qualifications and experience as specified herein.

12.02. Submit Prior to Construction. Subcontractor shall submit product data and sources of material. Subcontractor shall submit a plan and description of the Subcontractor's design of site operations including location of slurry ponds, bentonite storage, backfill mixing, and equipment laydown. The description shall discuss methods and procedures to be used to comply with the specifications. Subcontractor shall submit proposed methods and procedures for construction of flow zones in the completed barrier walls as specified herein.

The Subcontractor shall determine and test the SCB backfill design mix for approval by the Contractor. Testing shall be performed as outlined in Specification 02396 with sufficient strength and permeability testing to demonstrate compliance with the technical requirements. At a minimum, two tests shall be performed; one with 7% cement by weight and another with 12% cement by weight. Proposed testing methods shall be submitted to the Contractor for approval prior to testing. Test results shall be submitted to the Contractor prior to construction.

12.03. Submit During Construction. Subcontractor shall provide slurry tests, backfill monitoring, settlement monitoring, and other requirements specified herein.

End of Section

Section 02396 - LABORATORY TESTING OF HYDRAULIC BARRIER BACKFILL

1. SCOPE. This section covers all labor, equipment and materials required to prepare, acquire, package, transport and perform laboratory testing on samples of the Soil-Bentonite (SB) and Soil-Cement-Bentonite (SCB) backfill as outlined in this document. Testing of the trench slurry and additional barrier wall field testing requirements are described in Specification 02395.

2. GENERAL REQUIREMENTS. All testing shall be performed by the Subcontractor's laboratory, or an independent laboratory secured by the Subcontractor, staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards. The laboratory will be maintained at the construction site in a fully equipped and adequately maintained trailer, dedicated to testing operations. The laboratory shall be certified to perform tests on hazardous samples.

The Contractor shall be permitted to visit the testing laboratory prior to and during testing. All testing equipment shall meet the requirements of the references listed below and shall be subject to the approval of the Contractor. All test results will be reported to the Contractor immediately upon completion of tests.

The Subcontractor shall acquire, package, label, transport and store sufficient quantities of the SB/SCB backfill samples for testing. Duplicate samples shall be acquired, labeled and stored at the time of sampling and shall be stored by the Subcontractor for the duration of the project. These duplicate samples shall be made available to the Contractor at any time during the project for independent testing. Following the completion of the project, the Subcontractor must receive written approval from the Contractor prior to disposing of these duplicate samples.

3. REFERENCES. The following references are applicable to SB backfill testing.

All tests shall be performed in accordance with the latest revision of these standards, where applicable.

3.01. American Society of Testing and Materials (ASTM) Standards.

C 39	Compressive Strength of Cylindrical Concrete Specimens
C 143	Slump of Portland Cement Concrete
C 150	Portland Cement
D 422	Particle Size Analysis of Soils

D 1140	Percent Passing #200 Sieve
D 2166	Unconfined Compressive Strength of Cohesive Soil
D 5084	Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter

3.02. American Petroleum Institute (API) Standard Specifications.

API RP 13B Recommended Practices on Standard Procedure for Testing Drilling Fluids

Bulk Wet Density test method is outlined in Section 5.04.

4. SUBMITTALS. Prior to commencing testing the Subcontractor shall provide the Contractor with a statement of qualifications and experience of the laboratory intended for use, and shall obtain the Contractor's approval of the laboratory prior to the beginning of testing.

Demonstration copies of test report and test summary data sheets proposed for use during construction shall be submitted to the Contractor in advance of testing. Test reports shall be tabulated and include the following information at a minimum.

- 1) Sample Number
- 2) Location Sampled
- 3) Date and Time Sample Taken
- 4) Test Performed
- 5) Test Result
- 6) Copy of Test Data Sheets

Test results shall be submitted to the Contractor for approval prior to placing backfill.

5. EXECUTION.

5.01. Sample Acquisition. The Subcontractor shall acquire samples for testing. Samples shall be obtained from the backfill mixing area, the completed trench or as directed by the Contractor. The Subcontractor shall advise the Contractor before samples are obtained and tests are performed, to allow the Contractor an opportunity to observe sampling and testing.

5.02. Testing Frequency. Backfill shall be tested by the Subcontractor at the following minimum frequency.

<u>Test Method</u>	<u>Volume of Backfill Produced</u>
ASTM C 143 - Slump	500 c.y.
ASTM D 422 - Gradation	500 c.y.
ASTM D 1140 - Passing #200 Sieve	500 c.y.
ASTM D 2216 - Moisture Content of Fines Supplement	500 c.y.
ASTM D 5084 - Permeability	500 c.y.
ASTM D 2166 - Unconf. Comp. Strength of Soil or ASTM C39 - Comp. Strength of Concrete Cylinders	500 c.y.
Bulk Wet Density - (See Section 5.04)	

The Subcontractor may elect to perform additional or other testing at his own expense.

5.03. Sample Selection and Packaging. Sampling shall be performed in the presence of the Contractor. Samples obtained shall be representative of the backfill batch and be randomly selected from within the backfill mix. The quantity of sample obtained shall be adequate to perform the required suite of tests on previously untested fresh backfill. The Subcontractor shall obtain guidance from the testing laboratory on sample quantities required.

Samples shall be clearly labeled using a twist tie, with sample number, mix location, test type, date and time. If samples are acquired from the trench, the barrier construction location shall be recorded to the nearest foot. The sample number shall also be written with permanent marker on the bag. The outside of the sample bags shall be washed clean.

Samples shall be packaged in air tight re-sealable plastic bags of minimum 20 mil thickness, labeled, and stored in boxes. Unused materials will be stored as record samples and will be disposed of with written approval of the Contractor, only after the completion of the project.

Gravel sizes greater than 1 inch shall be removed by passing samples through a one inch sieve in the field.

5.04. Testing Details. Testing shall be performed in accordance with the reference standards and the details presented below.

5.04.01. Bulk Wet Density Test. Backfill bulk wet density testing shall be measured by placing the material in a 1/10 cubic foot Proctor mold of known weight, screening off excess, and cleaning and weighing the mold. The backfill sample shall be placed in three

equal lifts, rodding each lift 25 times allowing the rod to slightly penetrate the previous lift.

5.04.02. Permeability Testing. Prior to performing permeability testing the samples will be scalped to remove particles greater than the 3/8 inch sieve. Place SB/SCB backfill sample in to the rubber membrane in three equal lifts, rodding each lift 25 times allowing the rod to slightly penetrate the previous lift.

Testing shall be performed using variable head, flexible wall permeameters in accordance with ASTM D5084, latest revision. Following backpressure saturation, specimens shall be consolidated to an effective consolidation stress of 5 p.s.i.. During permeation hydraulic gradients shall not exceed 30. At no time during the test shall the backpressure exceed the cell pressure. The Contractor shall select the permeant to be used.

The constant volume ("closed loop") version of this test will be considered by the Contractor if demonstrated to the Contractor to be appropriate.

5.04.03. Strength Testing. Testing shall be performed on SCB backfill mix samples. Four samples shall be collected for each required interval of testing and placed in appropriate molds and cured. Testing methods shall conform with the required ASTM procedures. ASTM D2166 or C39 shall be applied based upon loading system limits and sample strength. Testing shall be performed on one sample after 7 days of curing and on the second sample after 28 days of curing. The remaining samples shall be stored for any needed additional testing until the completion of the project.

End of Section

Section 02512 - ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of labor, materials and equipment for the construction of asphaltic concrete base course, bituminous tack coat, and asphaltic concrete surface course for roadway, driveways and parking area repairs and patching as indicated on the drawings.

Subgrade preparation shall be as indicated in the earthwork section, unless otherwise specified in the governing standards or herein.

Asphaltic concrete paving shall be constructed to restore pavement cuts for utility line construction indicated on the drawings and as specified herein.

1-2. GENERAL.

1-2.01. Governing Standards. Except as otherwise specified or indicated, materials, equipment, details, and construction methods shall comply with the applicable provisions of the Delaware DOT 2001 Standard Specifications.

1-2.02. Coordination. Subcontractor shall coordinate the construction of asphaltic concrete paving with the excavation, the construction of concrete curb and gutters and other construction.

1-3. WEATHER LIMITATIONS. Minimum temperatures under which asphaltic concrete pavements may be constructed shall be as stipulated in the governing standards.

PART 2 - MATERIALS

2-1. SOURCE. The sources of materials shall be acceptable to Contractor. Except as modified herein, materials shall conform to the requirements of the governing standards. Delivery tickets for all materials delivered to the site shall be submitted to Contractor at the end of each day during the progress of the work.

2-2. ASPHALTIC CONCRETE. Materials shall be as required for Hot Mix, Hot Laid Bituminous Concrete in Section 823 of the governing standards.

2-3. DESIGN MIXES. Design mixes for the surface and base course shall be in accordance with the governing standard, Section 823. Design mixes, based upon the aggregates to be furnished, shall be determined by an independent testing laboratory at the expense of Subcontractor and shall be submitted to Contractor for review. The proposed design mixture data submitted for review shall include the following:

Marshall stability, all mixtures

Number of compaction blows

Flow, all mixtures

Percent air voids: (laboratory specimen)

Base

Surface

Percent voids in the following mineral aggregate:

3/4 inch [19 mm] max size

5/8 inch [16 mm] max size

3/8 inch [10mm] max size

PART 3 - EXECUTION

3-1. EQUIPMENT. Equipment and facilities for storage, measuring, mixing, heating, transporting, spreading, compacting, and other operations shall be in accordance with the applicable requirements of the governing standards. Improved or modernized equipment which will produce results equal in quality to those which would result from the specified equipment will be considered for use. All equipment and facilities shall be acceptable to Contractor.

3-2. SUBGRADE PREPARATION. Subgrade preparation shall be in accordance with Deldot Standards. The top depth shall be at least 6 inches [150 mm] and as indicated in Contract Documents. The subgrade shall be compacted to a percentage of maximum density of at least 95 percent at optimum moisture content and as indicated in the Contract Documents. Density shall be determined in accordance with the governing standard. In addition, the stability of subgrades shall be such that when materials for construction are deposited on the subgrade no rutting or displacement of the subgrade by material hauling vehicles will occur. No materials shall be placed on subgrades which are muddy, frozen, or have frost, snow, or water thereon. Subgrades shall be thoroughly compacted and properly shaped before any surfacing materials are placed. All subgrade and surfacing shall be sloped toward drains or outer edges.

3-3. PAVEMENTS. Unless otherwise specified, the new pavements to be constructed shall consist of an asphaltic concrete base course and an asphaltic concrete surface course, each of the thickness indicated on the drawings.

Grade control shall be maintained by Subcontractor by means of automatic screed controls on the paving machine and by use of erected and mobile string lines as applicable. The use of the automatically controlled paver may be waived by Contractor on irregular sections. Finished surfaces shall conform to the lines and grades indicated on the drawings.

The grade of asphalt to be used for the various mixes will depend upon the ambient temperature at time of application and shall be acceptable to Contractor.

Asphaltic concrete pavements shall be constructed on previously prepared subgrades in accordance with the sections as required of the governing standards.

Bituminous mixtures may be spread and finished by hand methods only where machine methods are impractical as determined by Contractor. Hand placed mixtures shall not be cast or otherwise manipulated in such manner that segregation occurs.

3-4. REPAIR OF DEFECTS. Subcontractor shall remove and replace defective areas by cutting to the full depth of the course. Cuts shall be made perpendicular and parallel to the direction of traffic with edges vertical.

A tack coat of emulsified asphalt shall be applied to all exposed surfaces. The area shall be filled with fresh hot asphaltic concrete mix in lifts of the same depths as the adjacent area, then compacted by rolling to specified surface density and smoothness.

3-5. CLEANING. After completion of paving operation, all areas shall be cleaned of excess spilled asphalt materials to the satisfaction of Contractor.

3-6. PROTECTION. In addition to the requirements for protection stipulated in the governing standards, Subcontractor shall protect all adjacent concrete and masonry so that no damage will occur as the result of subsequent construction operations. All damage or discoloration shall be repaired to the satisfaction of Contractor before final acceptance by Owner.

Special care shall be taken to prevent bituminous materials from spraying or splashing. Adjacent construction shall be protected by covering with suitable fabric or paper.

End of Section

SECTION 02600 - EXISTING UTILITIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the location, protection, maintenance, repair, and replacement of existing utilities affected by the Work.

1-2. GENERAL REQUIREMENTS. Subcontractor shall locate, protect, maintain, repair, and replace as necessary all existing utilities affected by the Work and as specified herein.

The measurement and payment for the work of this section shall be in accordance with Specification Section 01025 - Measurement and Payment.

Subcontractor shall perform the necessary site preparation, clearing, excavation, trenching, sheeting and shoring, dewatering, backfilling, and grading required for protection and maintenance of existing utilities in accordance with Specification Section 02200 - Earthwork.

1-3. REFERENCES. Subcontractor shall perform all work of this section in accordance with the Subcontract Documents and all applicable rules and regulations, codes, and ordinances of Local, State, and Federal authorities including, but not limited to:

- A. CFR, Title 29, Part 1926, *Safety and Health Regulations for Construction*.
- B. Delaware Underground Utility Damage Prevention Safety Act.
- C. Site Health and Safety Plan.

1-4. SUBMITTALS. Subcontractor shall submit to Contractor proof of utility location inspections, and product data for utility repairs and replacements. All submittals required by this section shall be in accordance with Specification Section 01300 - Submittals.

PART 2 - EXECUTION

2-1. LOCATION. Prior to the start of any excavation, Subcontractor shall field locate, to their own satisfaction, all existing utilities and related appurtenances at each property. Related appurtenances shall include, but not be limited to, poles, guy wires, standpipes, manholes, meters, valves, catch basins, gutters, and inlets.

In accordance with the Delaware Underground Utility Damage Prevention Safety Act, Subcontractor shall contact the Miss Utility of Delaware at (800) 282-8555 to locate existing utilities at each property involved in the Work. Subcontractor shall contact the Miss Utility of Delaware at least two (2) working days before and no more than 10 working days before the start of any excavation.

Subcontractor shall then confirm with Contractor that the call has been made.

2-2. NOTIFICATION TO UTILITY COMPANIES AND AUTHORITIES. Subcontractor shall notify utility companies and authorities at least 14 calendar days in advance when performance of the Work may affect them.

Work that may affect either storm sewers, sanitary sewers, or electric lines must be inspected by New Castle County. Subcontractor shall contact DNREC at (302) 739-4411. Proof of inspection shall be submitted to Contractor.

Subcontractor shall contact Conectiv Energy at (800) 375-7117 to coordinate all work performed near gas lines and gas appurtenances.

2-3. PROTECTION AND MAINTENANCE. Subcontractor shall take all necessary measures, including but not limited to shoring, bracing, and supporting to protect and maintain existing utilities throughout performance of the Work.

2-4. DAMAGE, REPAIR, AND REPLACEMENT. If Subcontractor damages any utility during performance of the Work, the necessary repairs or replacements shall be performed and temporary service provided in the interim, by and at the expense of Subcontractor. Subcontractor shall make all necessary repairs and replacements with new materials of the same type as the existing utility. Utility damage requiring repair or replacement by Subcontractor shall include breaking, causing a leak, denting, gouging, grooving, damage to exterior coating or cathodic protection, or other damage in the opinion of Contractor.

Subcontractor shall submit to Contractor product data for materials used to repair and replace damaged utilities.

Subcontractor shall handle and dispose of all excess materials generated as a result of utility repair and replacement, in accordance with Specification Section 01606 - Materials Handling and Disposal.

End of Section

Section 02630 - POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

PART 1 - GENERAL

1-1. SCOPE. This section covers buried polyvinyl chloride (PVC) pressure pipe that will convey groundwater. PVC pressure pipe shall be furnished complete with all fittings, jointing materials, anchors, blocking, encasement, and other necessary appurtenances.

Pressure and leakage tests are covered in other sections. Pipe trenching, bedding, and backfill are covered in the Earthwork section (Section 02200).

1-2. GOVERNING STANDARDS. Except as modified or supplemented herein, all PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 and C905.

The supplementary information required in the governing standards is as follows:

Affidavit of Compliance	Required.
Plant Inspection	Not required.
Special Markings	Not required.
Special Preparation for Shipment	Not required.
Certification	Required.

1-3. SUBMITTALS. Drawings and data shall be submitted in accordance with Specification Section 01300 - Submittals. Drawings and data shall include, but shall not be limited to, the following:

Gasket material.
Pipe length.
Affidavit of Compliance (ANSI/AWWA C900, Sec. 1.4).
Affidavit of Compliance (ANSI/AWWA C905, Sec. 1.4).
Certification (ANSI/AWWA C900, Sec. 2.1.4).
Certification (ANSI/AWWA C905, Sec. 2.2.2).

1-4. STORAGE AND HANDLING. Pipe, fittings, and accessories shall be handled in

accordance with Chapter 6 of AWWA Manual M23, to ensure installation in sound, undamaged condition. Pipe shall not be stored uncovered in direct sunlight.

PART 2 - PRODUCTS

2-1. MATERIALS.

Pipe	Schedule 80, Type I ASTM D-1784 bell - and - spigot.
Fittings	Schedule 80, Type I ASTM D-1784, socket on pipe runs, threaded in well vaults.
Joints	
PVC to PVC	Schedule 80 PVC, socket on pipe runs, threaded in well vaults.
PVC to Cast Iron	Schedule 80 PVC, molded-in-place brass threaded inserts, stainless steel reinforcement collars. Elbows, adapters, and tees have Buna-N O-rings and unions have viton O-rings. Socket end PVC, NPT end is metal.
Joint Tape	Self-sticking, PVC or polyethylene, 10 mils thick; Chase "Chasekote 750," Kendall "Polyken 900," or 3M "Scotchrap 50."
Conductive Tracer	Detection tape, 3 inches wide; aluminum foil core, 0.5 mil thick, encased in a protective inert plastic jacket; 5,000 psi min tensile strength; 2.5 pounds per inch per 1,000 feet min mass; color coded in accordance with APWA Uniform Color Code; Allen Systems "Detectatape," Lineguard "Type III," or Reef Industries "Terra Tape D."

Manufacturing quality control shall be maintained by frequent, regularly scheduled sampling and testing. Testing shall comply with the governing standards or at the discretion of the

Contractor.

PART 3 - EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends and bells shall be examined with particular care. All defective pipe and fittings shall be removed from the site of the work.

3-2. LAYING PIPE. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in the earthwork section. Pipe shall not be laid in water or under unsuitable weather or trench conditions.

During cold weather, particular care shall be taken in handling and laying pipe to prevent impact damage.

Pipe shall be laid with bell ends facing the direction of laying, except when reverse laying is specifically permitted by the Contractor.

Foreign matter shall be prevented from entering the pipe during installation.

Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water shall be removed from the trench prior to removing the plug.

Pipe shall be kept shaded and as cool as possible during installation and shall be covered with backfill immediately after installation.

Conductive tracer shall be buried above PVC pipe, not more than 18 inches below the ground surface.

3-2.01. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.

3-2.02. Alignment. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the maximum deflections specified by the manufacturer.

Unless otherwise specified or indicated on the drawings, and subject to acceptance by the Contractor, either shorter pipe sections or fittings shall be installed as required to maintain the indicated alignment or grade.

3-3. CUTTING PIPE. Cutting shall comply with the pipe manufacturer's recommendations and with Chapter 7 of AWWA Manual M23. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and shall be beveled in accordance with the manufacturer's instructions.

3.4. JOINTING.

3-4.01. Stab-Type Joints. Unless specified otherwise, jointing shall conform to the instructions and recommendations of the pipe manufacturer.

3-4.02. Mechanical Joints. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Overtightening of bolts to compensate for poor installation practice will not be permitted.

3-5. CONNECTIONS WITH EXISTING PIPING. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the authority Owner. Facilities shall be provided for proper dewatering and for disposal of water removed from the dewatered lines and excavations without damage to adjacent property.

3-6. REACTION ANCHORAGE AND BLOCKING. All bell-and-spigot or all-bell tees, Y-branches, bends deflecting 11-1/4 degrees or more, valves, and plugs which are installed in piping subjected to internal hydrostatic heads in excess of 30 feet shall be provided with suitable reaction blocking, or other acceptable means of preventing movement of the pipe caused by internal pressure.

Concrete blocking shall extend from the fitting to solid, undisturbed earth and shall be

installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by the Contractor. If the absence of suitable solid vertical excavation face is due to improper trench excavation, the Subcontractor shall furnish and install acceptable metal harness anchorages using ductile iron pipe of the appropriate class at no additional cost to the Owner.

3-7. HYDROSTATIC TESTS. After installation, PVC piping shall be hydrostatically tested for defective workmanship and materials as specified in Section 02704 - Pipeline Pressure and Leakage Testing of the Subcontractor specifications.

3-8. LEAKAGE. All PVC piping shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of the Subcontractor.

End of Section